

Ideas From the World's Biggest Inventors Show

POPULAR MECHANICS

MAR. 1971
50 CENTS

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Self-
Focusing
Camera



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Trouble-Shooting Small Gas Engines • Weekend Projects

BOATS

What's New for '71 • Matching Hull to Horsepower
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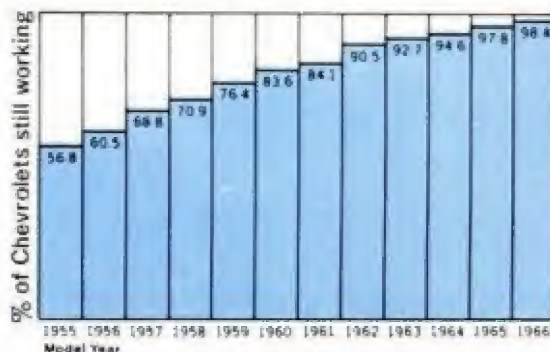
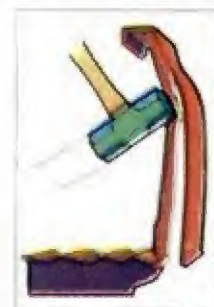


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MARCH 1971

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However, there are some hunters (especially women and youngsters) who prefer to carry a smaller and lighter gun, particularly when they're out all day, up and down hills, across fields, in and out of brush.

They often choose a 20 gauge gun. It's lighter, but with factory-loaded shotgun shells offering $2\frac{3}{4}$ equivalent drams of powder to push 1 ounce of shot, you lose the punch needed for long shots and you have to be darn good to make the close ones.

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The new 1100 is the only lightweight 20 gauge magnum gas-operated shotgun made today. Its solid-steel receiver and other parts are designed to pare away every possible ounce without impairing the 1100's long-established reliability. It weighs only about $6\frac{3}{4}$ pounds, a full quarter pound lighter than our regular 20 gauge 1100, and three-quarters of a pound lighter than our 12.

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Build the Yellow Jacket (The hot little air-cushion vehicle that hovers at 5 inches and goes up to 50 mph)

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- 10 Lifesaving Driving Tips. Be ready for highway emergencies.
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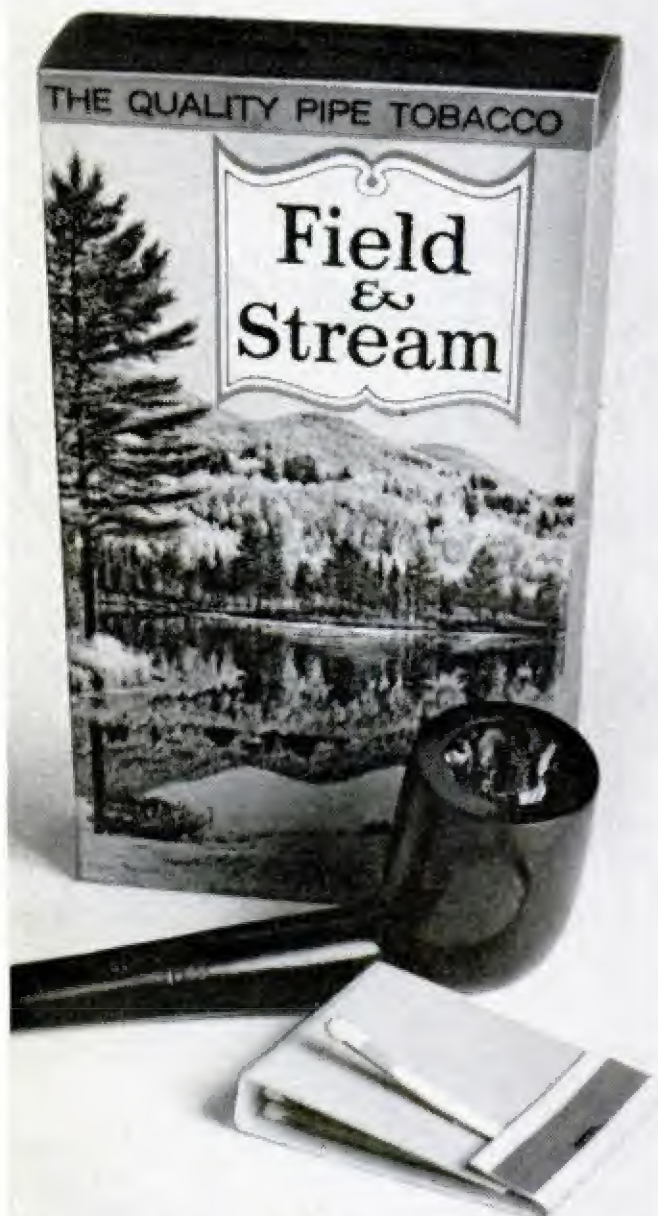
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LETTERS

TO THE EDITOR

License auto mechanics?

Should Mechanics Have to Have a License? (page 73, Jan. PM) is interesting.

I am an aircraft mechanic, and we have to be licensed by the FAA. An aircraft mechanic must have three years on-the-job training or two years of training at an FAA-approved school. Then he must pass both a written examination and a practical examination. The FAA issues a separate license for airframe work and one for powerplant work.

After three years of holding the license and working full time in the field of maintenance, a mechanic may take an examination to obtain an inspector's rating.

I think that automobile mechanics should be governed by federal laws just as we aircraft mechanics are. They are just as responsible for the safe condition of automobiles as we are for aircraft.

MORO, ILL.

JACK HARMON

No, no, a thousand times no! Mechanics licensed? I agree with Mr. Iacocca.

Is my doctor any better or my dentist or my druggist? Hell, no. It's like professional engineers—just a racket, a tight clique.

People are people. Having a license does not change them nor make them good or bad. If I do not like what one does or his prices, I can—and do—go someplace else.

Who the hell brought it up anyway?

NORTH WEBSTER, IND.

HAROLD A. LEACH

Middle-aged men on the streets?

In answer to Louis Smith who requested more articles on motorcycles (because "more and more middle-aged men are buying them"), you stated in your January *Letters*: "Really, we're in favor of keeping middle-aged men off the streets."

I surely don't know why! I bought my first "bike" in July 1968, rode it over 5000 miles in a year, traded up two years ago and have over 10,000 miles on this one. I always considered "middle age" about 35 because twice that is what most of us expect to live—and I was 55 before I thought I could afford a motorcycle. I've never had anything that gave me more fun since I learned to ride a bicycle.

So quit trying to run us off the streets. We've paid taxes longer than most of you guys, and we are more sensible riders than the young punks, I'm sure. Any middle-

(Please turn to page 8)

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Los Angeles, Calif.

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LETTERS

(Continued from page 6)

aged man who wants a motorcycle and can afford it should get it now! It's later than you think. And give us more motorcycle articles!

KANSAS CITY, MO.

W. E. GODFREY

Most of the young people today can't handle a *real* motorcycle. My husband owns both a Harley and an Indian cycle. They are a bit larger than the "toys" the kids today ride, and it takes a good man to handle one. Both my husband and I read and enjoy *PM* very much, and I can't remember that you've shown such apparent bias before.

FARIBAULT, MINN.

MRS. FRANK LEE

All middle-aged men should cancel their subscriptions to your magazine as I am doing, so please send me the balance of my subscription money, thank you, and I never will read your magazine again and I will tell all middle-aged men about this and show them your reply to Mr. Smith.

MARIETTA, N.Y.

FRANK L. WATKINS

Aw, c'mon, folks. We have a collection of mainly 40 and 50-year-olds putting out this magazine (aided up and down stairways, across streets and into wheelchairs by a couple of callow youths in their 30s), and we rank middle-aged men up there with Home, Mother and the Flag. As one colleague puts it: It's lucky there are still magazines around to work on; they keep middle-aged men off the streets.

Hippies are good, too

I enjoy reading *PM*. I was considerably irked, however, to see Wade Mitchell's stupid and bigoted reference to "... potentially troublesome groups (such as hippies) ..." in *On-the-Go Camping* (page 63, Jan. *PM*).

The term "hippie" is right down there with all other ugly terms of prejudice; so is the attempt to shunt the blame for society's bad elements off on one group.

THOUSAND OAKS, CALIF.

ROD SMITH JR.

Your reference to hippies reflects an ignorant and narrow-minded position. Why not mention the criminal who steals from campers or the rapist who takes advantage of unprotected women in our parks? Apparently the discrimination you mention exists and your article supports the fact that it does.

WEST HEMPSTEAD, N.Y.

KEVIN BOBIER

Wade Mitchell, it's people like you who

should be discriminated against if you can't find peace in your mind toward other types of people in this mixed-up, confused world of ours. Not all "hippies" are potentially troublesome groups, but as long as there are people like you around they will never get a fair shake. I hope your mind is not a "hard-hat" in order that this letter may make an impression on your future thoughts about your sons' and daughters' (if you have any) actions and other kids trying to find what they want and what they want to be.

TOWSON, MD.

THOMAS L. CAGLE

Telescope builders

In your *200-Power Telescope* (page 166, Dec. *PM* and page 152, Jan. *PM*), you quoted a price of \$4 for a 6-inch mirror kit from Edmund Scientific. This is incorrect. The kit costs \$13.95.

You also used an aluminum tube. A cardboard tube, designed for concrete forms, works very well for this purpose at a fraction of the cost.

It's nice to see this type of project in *Popular Mechanics*.

MILWAUKEE, WIS.

PAUL A. MURN

That error in price was our mistake. The kit does sell for \$13.95.

Should one be as close as possible to the 96-inch figure [focal length] before beginning to polish? What would be the consequence of grinding too deep? And approximately how long should the mirror be immersed in silvering solution for best results?

MOUNTAIN VIEW, MO.

ORVILLE F. SMITH

If you grind too deep, the curve can be corrected by grinding with the tool on top and the mirror in the barrel. Radius of curvature before polishing should be about 96 inches. Polishing has very little effect on the focal length.

The mirror should be immersed in the silvering solution about two minutes, or until a good coat has appeared. Longer will do no harm, but flecks may begin to deposit on the surface; they can be flushed away with distilled water.

About 40 years ago you had an article which started me on the hobby of telescopemaking. Since then, I have quite a number of scopes to my credit—from 6 to 12½ inches.

But I must say you are falling below par to print a story like the one in your December issue. It is not hard to make a telescope, but you have to have a detailed

(Please turn to page 10)



Mr. Blanton goes to school.

Eugene Blanton is chief mechanic at the First Baptist Church School in Charleston, South Carolina.

It's his job to keep its eight school buses coming to school every day.

"I'm here at eight when the buses start arriving."

Eugene says, "If there are any mechanical problems, I have to have them fixed before school gets out in the afternoon."

In the buses, as well as in his own two cars and boat, he uses Champion Spark Plugs.

"When I tune a car for a friend," he says, "I won't do it unless I can put in Champs."



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LETTERS

(Continued from page 8)

book on the subject so you don't waste your time and money on something you can't see the moon with, much less the rings around Saturn. You should have copied your previous article; it was much better.

BUFFALO, N.Y.

RUDOLPH NEUHAUSER

Racing Guide

In your 1971 *Auto Racing Guide* (page S1, Jan. PM), you show a painting of a McLaren car in the *Can-Am Cars* section. The caption states that the car is an M8D; if it is, the painting is inaccurate. The McLaren M8D has two fins, one on each side, by which the wing is mounted.

Also: Would the Bond Bug be suitable for conversion to a funny car; could it be run in Trans-Am?

FRANKLIN, IND.

DON ROUTIER

The caption says that Team McLaren won in M8Ds (which is correct). The M8D does have two fins. However, what the caption does not say is that the painting is of an M8E—successor to the D model—which will probably run in 1971.

The Bond Bug could be funny, but it couldn't run in the Trans-Am because it doesn't have four wheels.

Firing those plugs

The importance of filing the electrodes on sparkplugs to reduce the firing voltage required is a point not generally appreciated (*How to Service Sparkplugs*, page 146, Jan. PM). Firing can also be improved during starting by only slightly depressing the accelerator. This decreases the effective pressure in the cylinders, also making the plugs fire at a lower voltage as well as reducing the load on the starter. It may make it possible to start when the ignition is in poor condition.

KENSINGTON, MD.

JAMES O. SPRIGGS

Annual Index

One of my nicest Christmas presents was the announcement that there will be an Annual Index available in December. I would like to thank the person responsible for such a simple, but tremendous, help.

ATLANTA, GA.

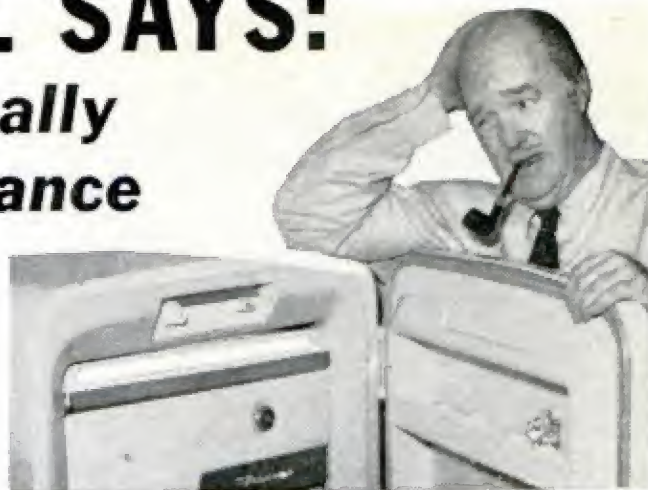
JULIUS HUGHES, DDS

It will cover the year 1971 and will include an attractive shelf cover for all 12 issues. Our Special Projects Editor is the guy who's responsible.

★★★

TOM McCAHILL SAYS:

"A Smart Guy Can Really Clean Up in the Appliance Repair Field"



Those electrical gadgets you have around your house are great on convenience, but if you're like a lot of do-it-tomorrow Johnnies, you don't know where to turn when one breaks down. So you call one of the busy Appliance Servicemen in your town, then drink instant until that fancy automatic coffee pot is perking again.

People have so many electrical appliances, it's no wonder Appliance Repairmen are busy as a bear in a bee nest. Count yours. The average home has at least a dozen, maybe more. There are better than 800 million appliances in the U.S.A. right now. No wonder the man who knows how to service appliances properly is pocketing \$4 to \$6 an hour, for as many hours as he cares to work!

If you're interested in making money (and who isn't), here is a job field crying for good men. And it's no sweat at all to get the training you need. Thousands have trained with National Radio Institute's Appliance Division. NRI has a great, low-cost home-study program covering every type of Appliance repair in detail. You study at home, in your spare time, learning through actual practice how to fix home, commercial and farm appliances. And not just the little stuff, either. Besides cantankerous coffee pots and toasters, you can learn how to repair air conditioners, refrigeration equipment, even small gasoline engines—and that's where the big bucks are, in the major appliances you'll fix.

NRI is one of the biggest and best schools in the home-study field. They have this Appliance Servicing course worked out to the most nit-picking detail. Yet, you'll be amazed at how little it costs. You even get a 25-buck professional Appliance Tester without extra cost. With your Tester and a few basic tools you probably have in your house, you'll be doing repair work long before you finish the course. And you can work anywhere—

in a corner of your basement, in the garage, even on the kitchen table.

NRI has been in home-study education since 1914. Experienced, well-trained instructors on the staff of 150 in Washington, D. C., give you all the personal attention a man could ask. You don't even need a high school diploma. Take it from Uncle Tom . . . this can be one of the easiest and most rewarding businesses you'll find today, either full-time or in spare hours. As a matter of fact, knowing how to service Electrical Appliances can pay off even if you don't want to strike out on your own. That coffee pot on the fritz probably needed ten minutes of a repairman's time to be perking again like the mudpots in Yellowstone Park. You can do it yourself with the training NRI gives you. And if you're thinking about Social Security years, this is a great way to pick up some money and keep yourself busy at the same time.

There's nothing to lose except a postage stamp and the energy it takes to walk to the mailbox. What you'll get for your efforts is the newest NRI Appliance Servicing catalog. Nobody is going to ring your doorbell to pressure you into signing an enrollment blank. NRI doesn't employ salesmen.

Do yourself a favor and mail the coupon now—before you turn this page.

Tom McCahill

NATIONAL RADIO INSTITUTE, APPLIANCE DIVISION
3939 Wisconsin Avenue, Washington, D. C. 20016

APPROVED UNDER NEW GI BILL
If you served since January 31, 1955
or are in service, check GI line below.

600-031

OK—I want to see for myself. Send me the free book on Professional Appliance Servicing. No salesman will call.

Name Age

Address

City State Zip Code

Accredited Member National Home Study Council.

Check for facts on new GI Bill.

Is your camper pickup built from scuttlebutt?

Most camper pickups are built around campfires and over backyard fences.

That's because almost everyone has a favorite opinion about the way a pickup should be set up for camping. Even if they've never owned one.

Like most information, it loses something in the passage from one person to another. Personal prejudices override the facts and the guy who once read something somewhere begins to sound like an expert.

That's the kind of free advice nobody needs. Because it often winds up costing plenty. But until now, that was the only kind you could get.

What you really need are the facts. A camper pickup is no small investment. And you're going to have to live with it a long time. You need the facts, not scuttlebutt.

They start with the INTERNATIONAL® 1210 Camper Special pickup.

The least important thing about a camper pickup suspension is how smoothly it rides.

Camper pickup suspensions are bought and sold by the seat of someone's pants.

The "Gee, it doesn't ride like a truck" smile on a prospect's face is the car salesman's first foot in the door.

Not that a soft, cushy ride doesn't have its place. It does. In a car.

A truck should ride like a truck for good reasons. Stability, safety and heavy load capabilities are the prime ones. And trucks have leaf spring suspensions.

The International 1210 Camper Special pickup is a truck. So it has leaf springs all around. And what little it loses in the smoothness department, it more than gains back in others.

It's easiest to think of it this way:

A coil spring gives you one point of suspension per wheel. A leaf spring gives you two.

In a pickup with coil springs all around, you get a total of 4 points of suspension. In a pickup with coils in the front and leaf springs in the rear,

you get a total of 6 points of suspension. In the International 1210 Camper Special pickup, with leaf springs all around, you get a total of 8 points of suspension.

At 60 mph, with a stiff crosswind, a GVW of 7,000 pounds and a curve just ahead, how many points of suspension would you want under you...4, 6 or 8?

A lot of pickups and cars have one thing in common: Their engines.

There's a common misconception that any engine, so long as it's bolted in a truck, is a truck engine.

That isn't so.

It's a fact that most camper pickup engines are taken from other assembly lines. If these other lines happen to be automobile assembly lines, the engines are automobile engines. If those other lines have trucks on them, you get a truck engine in your camper pickup.

Our other assembly lines have trucks on them.

Here's what you get:

Manufacturer	Engine	Rated HP:	Net HP:
International	V-304	193.1 @ 4400 rpm	173.0 @ 3900 rpm
	V-345	196.7 @ 4000 rpm	182.3 @ 3900 rpm
	V-392	253.0 @ 4200 rpm	235.9 @ 3600 rpm
Manufacturer "A"	302 V8	205.0 @ 4600 rpm	150.0 @ 4000 rpm
	360 V8	215.0 @ 4400 rpm	177.0 @ 4100 rpm
	390 V8	255.0 @ 4400 rpm	180.0 @ 4000 rpm
Manufacturer "B"	307 V8	200.0 @ 4600 rpm	135.0 @ 4000 rpm
	350 V8	250.0 @ 4600 rpm	170.0 @ 4000 rpm
	402 V8	300.0 @ 4800 rpm	240.0 @ 4400 rpm

International engines lose less horsepower between the test stand and actual use because they're truck engines. They have to be more efficient.

You'll also notice that they develop their power peaks at a lower rpm. They don't have to work as hard, so their chances of lasting longer are better. And they're all set to run on regular

or low-lead content gas.

International V-8's are, in fact, the same engines we use in many of our gas-engined highway rigs. And you know how long they last.

When you buy a pickup, make sure you get a truck.

There's more to a camper special pickup than an engine and a suspension system.

Transmissions, for instance. You can order any one of seven different transmissions—two 3-speed, two 4-speed, and a 5-speed heavy duty, a 5-speed with overdrive, and a rugged 3-speed automatic. Like the engines they're attached to, they're truck transmissions. They're strong.

Special additional equipment items. A front anti-sway bar and over-size electrical and cooling systems are standard on International Camper Special pickups.

Idiot lights. You can't get them with an

International. Gauges are standard equipment. So you always know what's going on.

Fuel tank location. International pickups are the only pickups with the tank outside the cab. Everyone else's tank is right inside, behind the passenger seat.

There's a truckload of other things to consider—power steering and brakes, air conditioning, AM-FM, the works. Your International truck dealer has the facts on them all.

Stop by and see him. Ask him about the 1210 Camper Special pickup. And let him help you separate fact from the fiction.

IH.
INTERNATIONAL® TRUCKS

International Harvester Company, 401 N. Michigan Avenue, Chicago, Illinois 60611.



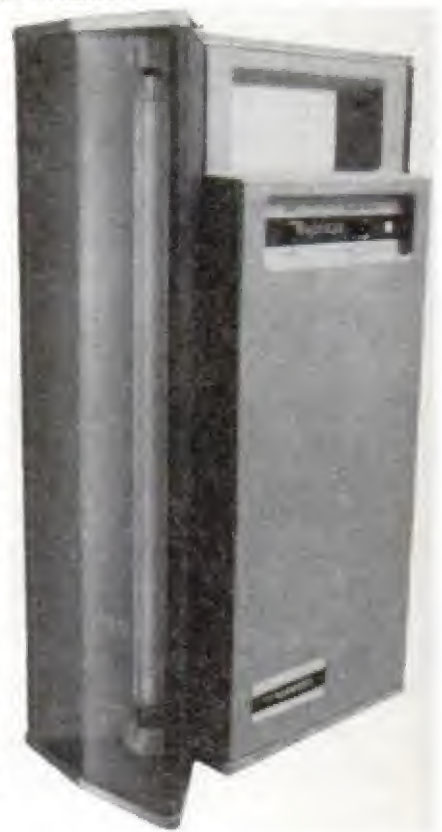


FOR BOATING, camping or vacationing convenience, try the 100 percent self-contained portable toilet, Porta Potti 1000 (above), needing no fresh-water hookup or permanent holding tank. Made in two sections—seat, seat cover, four-gallon water storage; and holding tank with pedal. Just unclamp and carry holding tank to permanent toilet for evacuation. Thetford Corp., Box 1285, Ann Arbor, Mich.



FLUORESCENT LANTERN

made by Burgess will add to your enjoyment of outdoor activities. Available in a beige, blue or gold polystyrene and vinyl case with stainless-steel trim, it operates on heavy-duty batteries or plugs into an a.c. outlet to give shadow free light across a 110° field. A Lucite shield protects 12-in. bulb and enamel reflector increases intensity of the light. Lantern is equipped with rubber feet on base, also has sturdy chain to hang it overhead. It retails for \$39.95 from Burgess Battery Div. of Gould, Inc., Freeport, Ill. 61032.



CONVERT YOUR GASOLINE OUTBOARD into a silent, electric fishing motor with the Electra Pal "Papoose," a permanent-magnet motor that rides piggyback on your motor's anticavitation plate. Less than a foot long and weighing about 9 pounds, it comes with a movable speed-control console you can clamp at any steering position. The motor, made in two models, operates from a 12-volt car battery. You steer it the same way you guide the outboard. For more information, write "Papoose," Osborn Engineering Corp., 1400 East Lafayette St., Bloomington, Ill. 61701.

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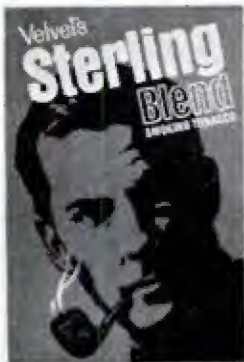
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DOES WORK OF \$75 BENCH SAW as is. Converts easily to equal any \$300 floor model cabinet units! Crosscuts, rips, mitres, cuts compound angles, dados, makes coves and mouldings.

\$1995 f.o.b. factory. Wt. 25 lbs. Incl. completely assembled cast iron and steel 8" saw with ground cast iron table, blade guard, less blade. **RIP FENCE**, if desired, for easier work alignment, \$3.50 add'l.

PRECISION BALL BEARING SPINDLE for Commercial Service, \$5.00 add'l.

SAW BLADE TILTS... TABLE STAYS LEVEL

Locks securely at any angle up to 50°, raises, lowers 0°-2 1/4". Patented tilt mechanism, accurate etched scale. Patented motor mount takes std. 1/4 h.p. or larger motor, keeps belt tight, assures perfect alignment at any angle, transmits full power. Takes std. blade, saw insert removes to take dadoe heads, cutters, etc. (not incl.). Accurate mitre gauge assembly. Ground spindle. Enclosed steel base. "Compo" bearings. Accessories available at factory prices. **RIP FENCE**, if desired for easier work alignment: Std. size (for bench saw) \$3.50; larger fence (for cabinet base, as ill'd.) \$4.50.

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\$1495 f.o.b. factory Wt. 14 lbs. Optional faceplate for turning bowls, trays, lamp bases, rosettes, etc. \$2.50. Set of 3 high speed turning chisels, \$4.95 add'l.

DOES THE WORK OF \$40 UNITS... with same precision and speed. Turns wood, plastic. Sturdy cast iron with tubular steel bed. Ball thrust cup center, spur center, T-rest assembly, lever action tail stock, 2-speed pulley. Fits any motor.

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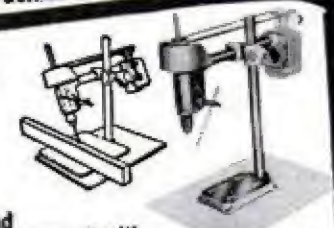
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DOES THE WORK OF \$60 UNITS... Professional power planing at a hand tool price. Make faster, more accurate joints, rabbetts, bevells for windows, doors, drawers, square tapered legs—Adjustable precision ground cast iron tables. Patent-pending design holds knife to table clearances at any depth. Rabbett depth 3/8". Fence adjustable 0°-50°. Hardened, ground hi-speed steel knives. Dual cutter guards. Balanced cutter head.

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All cast iron and steel
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Wt. 30 lbs.
1/2" cap.
Jacob's chuck incl.



DOES WORK OF \$90 UNITS... and much more. Industrial quality precision unit with all standard features, many extras. Head raises, lowers. Depth of throat up to 16". Pre-set to any angle for on-or-off table drilling, even horizontal drilling. **10-YEAR FULL SERVICE GUARANTEE.***

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But maybe you've *been* thinking about it—for too long. Don't *just go on* thinking . . . and thinking . . . while the raises and promotions keep going to the other guy. *Every day you wait costs you money*—according to a recent survey the average ICS graduate is making \$1200 more a year within a year of graduation—and many do far better.

Every day you wait is another opportunity lost. The opportunity is here—on this page—*now*. Read the attached booklet. ICS has been successfully training people to move up in the world, for over 80 years. ICS can help you.

ICS is America's most successful teacher. It teaches skills, and teaches success. It can teach *you* success. In any of 266 programs for a brighter, better-paying future.

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Unexpected reactions to nitrous oxide ("laughing gas") by college-aged patients recently aroused the curiosity of two Boston University dentists. They noted that administration of the gas made some patients more placid than was to be expected, caused others to be unusually active while under treatment, and produced prolonged aftereffects in a number of patients. Investigation revealed that all had used marijuana the day of the appointment or the evening before, and that adverse reactions did not occur if marijuana was avoided prior to dental treatment. The researchers also noted that an increase in nitrous-oxide dosage was required for consistent marijuana users, possibly because of a tolerance buildup. The scientists believe that the hallucinatory effect and euphoria produced by marijuana are reinforced by the similar effects of nitrous oxide.

A record simulated wet dive to 1100 feet was recently accomplished by five divers during a test of a new helium-oxygen, closed-cycle breathing rig at the Taylor Diving & Salvage Co., Belle Chasse, La. The test was carried out in a big steel pressure chamber filled with 7000 gallons of salty water cooled to 29° F. At depth, the men breathed a mixture of 99 percent helium and 1 percent oxygen. The old simulated wet-diving record of 1025 feet was established two years ago at the Navy's Experimental Diving Facility in Washington, D.C. The "dry" diving record of 1709 feet, not involving underwater immersion, is held by the French.

Promethium, an unstable element that doesn't exist naturally on Earth, has been identified in the spectrum of a star by University of Michigan astronomers Margo Aller and Charles Cowley. Designated HR 465, the star is in the constellation Andromeda at the edge of the Milky Way and only faintly visible to the naked eye. Promethium was originally discovered in 1947 as a fission product of uranium.

The hazards involved in experimenting with lasers are spelled out in a new 117-page manual issued by the Department of Health, Education and Welfare (HEW). Intended as a safety and experimentation guide for high-school and college instructors, the manual states that even low-power lasers can cause eye damage when improperly used. Since 1965, HEW has received reports of four laser-induced injuries at universities. Copies of Laser Fundamentals and Experiments may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D.C., 20402. Cost: \$1.25 per copy.

Why has the eastern United States and other parts of the world experienced a cooling trend in recent years? Some scientists think air pollution is blotting out sunlight and others suggest that we may be experiencing a cyclical variation in energy output of the sun. A more likely cause, according to Jerome Namias, chief of the Extended Forecast Div. of the National Weather Service, is the oceans, which act as a kind of governor of global climate. Water in the North Pacific has warmed up in recent years, he says, causing shifts in the high-level river of air known as the jet stream. This shift causes cold air to sweep down from the Canadian Arctic and across the eastern two-thirds of the United States. Scientists can't pinpoint the reason for the warming trend in the North Pacific.

SOS from the nursery. This distress signal may be heard in American homes if a new type of diaper fastener catches on. The fastener is an electrified safety pin with its own power supply. When baby wets, moisture closes a circuit to a miniature radio transmitter that sends a signal to a loudspeaker-equipped receiver. A California inventor was recently granted a patent for the fastener. ★★★

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Tacker Gun can
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Use the Model 800 Heavy-Duty Tacker Gun to install ceiling tile... repair screens... lay carpet... insulate... weather-strip... upholster... you-name-it!

Takes 5 staple sizes, from 1/4" to 9/16" — plus special Loktile® staples for ceiling tile installation. Easy to load — easy to operate.



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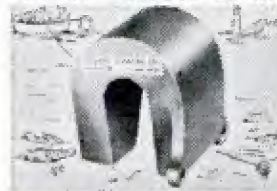
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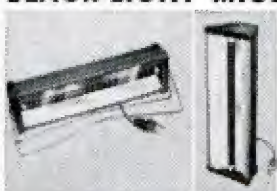
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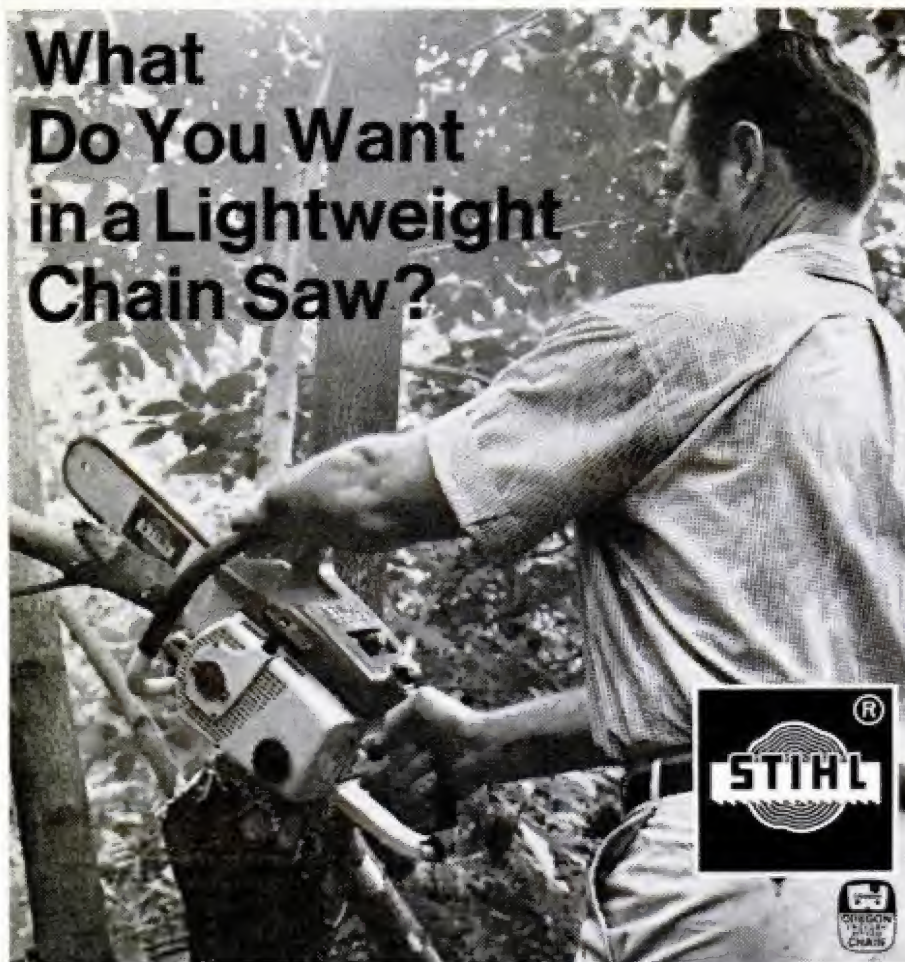
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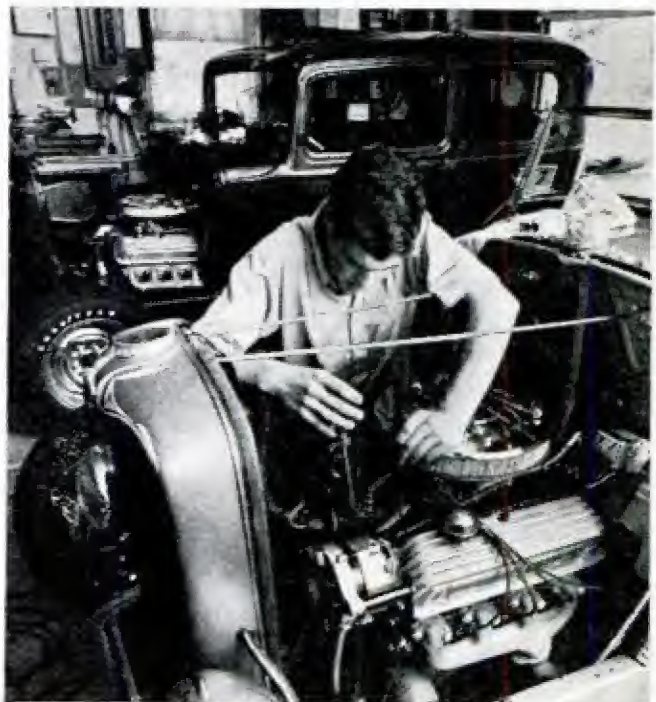
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DETROIT LISTENING POST

BY ROBERT LUND

WAS VW RIGHT ALL ALONG? Is Detroit finally swinging around to the view that there's something to be said for not changing models every year—staying with the same package as long as a car sells in fair volume? That's one interpretation industry outsiders offer to explain the lack of styling changes on cars coming this fall.

It's true there won't be many major reworkings of '72 cars, but not because Detroit is backing off from the annual model change. The reasons car companies won't spend big money reshaping the metal this year are financial, uncertainty over government standards and, in the case of GM, because it lost three months of '71 model production while closed by a strike. But, as we see it, Detroit's still very much committed to the idea of something new or make-'em-think-it's-new every year.

GM'S EYEING FALL OF 1972 as a target for introducing fuel injection on its cars. Some of 'em. But it could be two years after that (fall of 1974 when the '75s come out) before all GM cars switch over to F.I. And that's assuming something better doesn't come along in the interim.

CHRYSLER DIDN'T TELL ALL in disclosing it has shelved its small car, R-429. As originally envisioned, R-429 was to be more midi than mini. Big C decided to take a second look at the project late last year in the light of reports that Ford and GM are researching cars smaller than Pinto and Vega. The question that has Chrysler hung up for an answer is whether it should bring out a car the same size as Vega and Pinto or go more mini than those makes. What happens to R-429? There's probably some salvage value in the plans for the car, but the original will never go into production.

THERE COULD BE ANOTHER FORD CAR IN A YEAR OR SO, if the company can find manufacturing capacity to produce it and providing the customers are still hot for compacts. If it comes off—and there's a lot of weaseling in that if—it will be a deluxe Pinto; renamed, of course, and sold out of Lincoln-Mercury shops. The price would middle somewhere between Pinto and the current Comet. With Pontiac adding Ventura II to its line, that GM division will have five cars against four for L-M. L-M has a five-car catalog if you count its import, Capri. But Ford believes L-M should match Pontiac domestic car for domestic car to hold its own against GM competition.

DETROIT-STYLE HORSEPOWER RACE FOR THE IMPORTS? Not in large cubic leaps, certainly, but displacement of import engines has been creeping upwards of two liters (122 cu. in.). Among cars with bigger engines is the Fiat 124 Sports series, the Spider model (below). The twin-overhead-cam four is up to 1608 cc from 1438 in '71 models. The extra performance was well received by this driver and will make the 124s



even more appealing than they already are to sports-car enthusiasts operating in the under-\$4000 bracket.—*B.H.*

GM AND FORD, along with several supplier companies, are checking out various nonmetallic materials that might be used to make a new (to private passenger

(Please turn to page 32)



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DETROIT LISTENING POST

(Continued from page 30)

cars) type of gas tank. The tank's divided into compartments that seal off in the event of a puncture or fire. The idea has been used in race cars, but hasn't been applied to production automobiles.

FEWER SEDANS for five and six passengers will be built in the mid-'70s than now, predict engineers at work on '74 and '75 cars. Most cars are coming down in size, including interior dimensions. The auto companies aren't abandoning motorists with big families, who need room for more than four people, but they feel they can supply most big-family requirements with station wagons. The predicted trend to four-passenger cars is partially based on the expectation that families will grow smaller as the movement to control population gains ground. Fewer children per family, so there will be less of a demand for oversize cars.

WHAT'S WITH THE WANKEL? Everything out of GM up to now has indicated the company's interested in the engine to power a pint-size car—something smaller than Vega. But that may not be entirely accurate. All the auto companies, GM included, foresee cars shrinking in size. (See previous paragraph.) While the Wankel's most likely to be used in a mini, it might also be used in what will be considered standard-size cars in the mid-1970s. Standard size in 1974-75 could be squeezed down substantially from what it is today.

NEW PONTIAC COMPACT is due in dealer showrooms this month. The car, called the Ventura II, is on a 111-inch wheelbase and eight inches shorter than



the T-37 intermediate. Base engine in the 194.5-in.-long, two or four-door Ventura line-up is a 250-cu.-in. Six. A new 307-cu.-in. V8 is optional. Both engines operate on 91 octane no-lead or low-lead fuel. The standard transmission is a three-speed manual column-mounted.

Available later in the model year will be a Sprint option—a dressed-up version

(Please turn to page 34)



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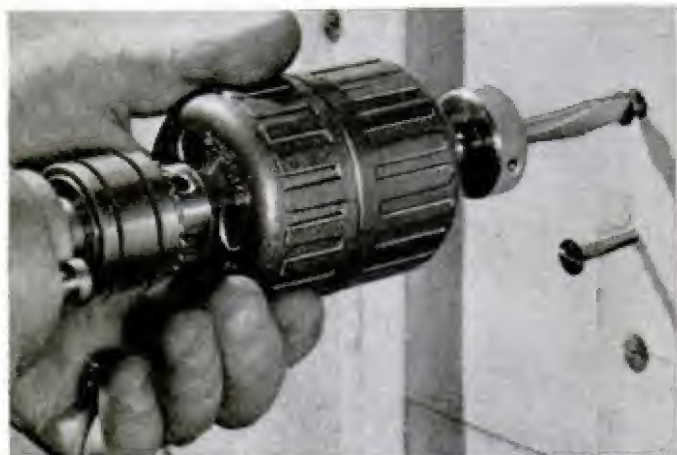
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EMERSON

(Continued from page 32)

including three-speed floor stick, wide tires, sport steering wheel, and special trim and striping.—B.H.

WHAT WOULD YOU SAY to a car put together from sweepings off the factory floor? That's laying it on stronger than the facts allow, but it makes the point. Scrap dealers who pay the auto firms for the privilege of carting away metal chips and trimmings say there's less and less scrap coming out of GM plants. The reduction in waste is partially due to GM's machining methods. It gets the most of each piece of metal with a minimum of throwaway. But over and above that, GM's coming up with ways of reclaiming metal it used to sell off as scrap. GM hasn't said so, but it's working toward a goal of reusing every last shaving.

WOULD YOU GO FOR OPTIONS of a full four-wheel antiskid braking system and air bags on your next car? Both items are ready now, or nearly so, and could be installed on '72 cars. Could be, but won't. Another instance of Detroit dragging its feet until the government steps in and orders such equipment put on cars? No, it's not the old collective conspiracy theory.

In the case of four-wheel antiskid brakes, every auto manufacturer now has his own unit or one developed by a supplier company. The hardware's ready. But who wants it at \$300 and up? And that's a bargain price, possible only if the item sells in substantial volume. Chrysler gets \$351.50 for the four-wheel antiskid it offers on Imperial—the only domestic car you can buy with a four-wheel system. The number of takers for the Imperial device has been running at a rate of about a hundred a month. Not exactly what you'd call a stampede.

How about air bags? There are so many unresolved questions about them that the auto companies can't even give the gear away so they can conduct research programs. Ford tried to do just that—give 'em away, put them on fleets, police cars or whoever would have them. There's a catch to the Ford offer. If you're injured as a result of the bags popping off, you get the hospital bill. Or your heirs get the bill for the funeral, if it comes to that.

Detroit isn't holding back on anything. The purpose of the game is to sell cars and all the extra gizmos that can be loaded on. If there's a conspiracy against the customer, it's to sell him more machine than he needs, not less. ★★★

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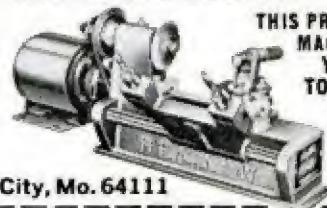
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BY CATHERINE BILSKI

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A BOUNTY of exciting ideas for all ages, talents and tastes is described and illustrated in the booklet *Accent on Crafts*. It presents step-by-step, full-color photographs and easy-to-follow directions. Even the novice craftsman can create projects for all occasions. Available in paint and hardware stores or craft and hobby cen-

ters, the booklet may also be ordered by mail for \$2 from Judy Martion, Creative Crafts Director, Illinois Bronze Powder & Paint Co., Lake Zurich, Ill. 60647.

A POCKET-SIZE 16-page brochure containing filter and film data has been released by Spiratone, Inc. Entitled *Filter and Film Speed Information*, it explains the uses of filters for color and black and white film, of lens attachments such as diffusers, polarizers and special-effect filters, has tables on close-up photography with regular and telephoto lenses and gives speeds of all popular films. For a copy, send 10 cents for handling to Spiratone, Inc., 135-06 Northern Blvd., Flushing, N.Y. 11354.

POROUS METALS are explained and illustrated in a new eight-page booklet, *What You Should Know About Ucar Porous Metals*. A suggested application chart describes the use of Ucar porous metals for abradable seals, filters, bearings, brake linings, acoustic liners, fuel cells and batteries, catalysts and phase mixers. For a copy of booklet CP-4037, write New Business Ventures Dept., Carbon Products Div., Union Carbide Corp., 270 Park Ave., New York, N.Y. 10017.

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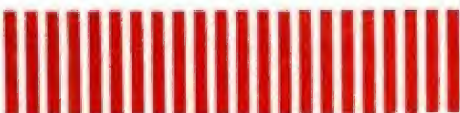
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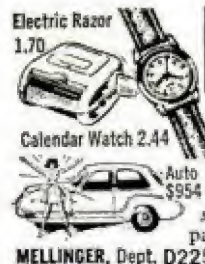
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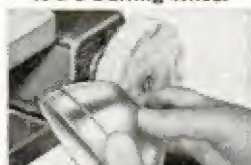
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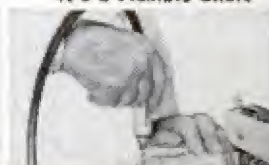
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The Transport 500 Wide Oval puts more rubber on the road for more stability and a whisper-smooth ride. And up to 50% more mileage than the Firestone tire it replaces.

The Traction All Season runs cat-sure, cat-quiet on the highway. Now get off the highway and feel its rugged lugs pull your rear wheels through mud or snow.

Get them at your Firestone Dealer or Store. Specify them when you buy a new light truck. The more you drive, the more you need them.

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LITTLE CHANGED from the first, 1948 model (background) is the current 88-in. wheelbase Land-Rover

The Land-Rover— Is It Really Indestructible?

By DAVID LAMPE

GREAT BRITAIN ended World War II with a stockpile of aluminum sacrificed by patriotic housewives. Steel went to the makers of essential vehicles and to auto producers with the best prewar export figures. This really hit the Rover Car Co. low. In 1947 Rover people began to think about the American Jeep that one of the company's bosses, like a lot of British gentlemen farmers in those days, actually seemed to like to drive. Why not a British Jeep with four-wheel drive for British farmers? Just, of course, to help the factory coast through the austerity period? At the Amsterdam Motor Show in 1948, barely a year after they first got the idea, the Land-Rover—so named because it was modestly intended as a farm vehicle—was

unveiled. Since then it has made its way literally to every corner of the world.

All steelwork, including the hulking ox of a chassis, was heavily galvanized, making it likely to remain free of rust forever. All body work was stamped out of aluminum—in small, bolted-together units, to keep repair and tooling costs down.

Everything was designed to be sturdy and simple because the Land-Rover seemed likely to end up in some colonial backwash where there might be no blacksmiths, let alone mechanics.

From the start the Land-Rover had a transfer case to give it eight forward speeds, two reverses and the option of four-wheel drive. Its power-takeoff facil-

(Please turn to page 46)



CONVERSIONS of Land-Rovers to specialty vehicles have been many; include special wheels, tracks, armor

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THE LAND-ROVER

(Continued from page 44)

ities, offered as factory-fitted accessories, are unique. The first is on the front of the 2286-cc, four-cylinder engine (petrol or diesel). A second is amidships, working off the transfer case and ideal for powering compressors for such tasks as painting and crop spraying or pneumatic drilling. The third power takeoff point is for a drive-shaft extending from the top of the main transmission to the rear of the vehicle. It powers buzz saws, threshers—even the drive wheels of a special cargo trailer.

Land-Rovers have always been able to negotiate axle-cracking ruts and wade happily through a foot and a half of water. Guaranteed to negotiate 45° slopes, given any kind of footing, they can usually handle 60° ones.

Land-Rovers beat it into the bush so

often that the Solihull factory now runs its own expedition-training school. After a blitz course in basic mechanics they discuss expeditioning: How to drive where the going is awful and, among other things, how to avoid stomach upsets where the food is doubtful, how to pack film for the tropics, how to swap money profitably in native bazaars, and even how to use a Land-Rover as a washing machine (you stuff your clothes into a watertight container, add hot water and soap flakes, then seal. Stow the container behind the driver's seat, and after a hundred bouncy miles your laundry's ready for rinsing).

The British Army has had several amphibious types of Land-Rovers. On the first prototype the exhaust merely discharged into the water, but for the final version someone decided the fumes should be ducted into the pontoons and then out

(Please turn to page 48)

The New Range Rover



HANDSOME, yet utilitarian, the four-wheel-drive Range Rover features a powerful V8 engine with twin carbs. Tailgate window hinges up, tailgate proper hinges down

What do you get when you cross a Land-Rover with a Rover luxury sedan? This all-purpose four-wheel-drive station wagon. Stubby, 14 feet, 9 inches long, the Range Rover has radial tires and everything underneath is neatly tucked up. It's much faster and more comfortable than the Land-Rover.

I drove a Range Rover across plowed fields at 40 mph and easily held a smooth, straight course. I steered deliberately into a steep, slime-filled bomb crater—one of a few left in England—and effortlessly out again. On an unpaved road three feet under water we keep going—pushing ahead a hood-high tidal wave.

The Range Rover's 156-hp aluminum 215-cu.-in. V8 engine is basically that borrowed from Buick to power Rover's most expensive sedans. Compression ratio has been cut to 8.5 to 1 to accept regular fuel. On freeways it does over a hundred, and it cruises comfortably and quietly at 90. Coil springs and telescopic dampers at each corner, plus a self-leveling unit, keep the ride smooth. Aluminum body panels and specially dipped steelwork mean no rusting. The eight forward and two reverse speeds are all synchromesh. Front-wheel drive can't be disengaged, but a third differential between the front and back prevents tire scrubbing on hard roads. For extra road bite you lock this differential with a vacuum switch, even when the wagon is in motion.

The only fault of the Range Rover is a tendency to over-steer in tight corners. You learn to control this in about two minutes. They should arrive in the United States near the end of the year, priced between \$5000 and \$6000.—D.L.

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The groundskeeper is Ford's fine line of dependable lawn and garden tractors. Seven models altogether. From the 7 hp model 70 lawn tractor to the 14 hp model 140 lawn and garden tractor with hydrostatic transmission. Each one built to keep your lawn and grounds looking estate-clean. Over 50 attachments available for four-season use.

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LAND-ROVER 109-inch station wagon can be set up as 10 or 12-seater. Engine is six-cylinder, 160-cu.-in.

THE LAND-ROVER

(Continued from page 46)

again through balancing valves. Thus, if the pontoons are punctured by bullets or by anything else, they'll stay inflated as long as the engine keeps running!

Terrible things sometimes happen to Land-Rovers. One got caught in a desert storm in Iran. It emerged five hours later, its crew in a state of abject terror but physically unhurt. Not a scrap of paint was left on the car's aluminum sides and top. It had been sandblasted clean!

Another Land-Rover charged through an Australian bush fire, carrying a dozen foresters on a ride they'll never forget. The heat became so intense that the tires began to melt. The windshield cracked and became almost opaque. And the gas in the tank began to steam and hiss. But the Land-Rover got its passengers to safety.

What of the vehicle's future? "Well," says Tom Barton, Rover technical director, "we can probably go on making them forever, if we want to."

Only cost has kept such luxuries as overdrives and automatic transmissions out of Land-Rovers. The cost of the aluminum for bodies keeps rising, but there's no suitable replacement material. Steel can't be rustproofed to Land-Rover standards, and every plastic Barton has examined has been weakened by fatigue.

Anyway, any drastic change in the Land-Rover would start owners howling all over the world. Most of the 675,000 Land-Rovers so far built are still going strong despite the strange, unique attitude their owners tend to have toward them. Give the most reasonable man a Land-Rover and he won't be happy till he's tried to bash it to death. All over Britain there are Land-Rover-owning farmers who brag—brag, mind you—that they've driven the same one for 20 years and have never had it serviced!

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Wall-to-wall carpeting, upholstery, walls: 3 great needs for on-location cleaning

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Since this carpeting can't be sent out for cleaning there's a real opportunity for on-location cleaning services. It's faster, easier and inexpensive to clean carpeting on the customers' premises.

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Now, consider wall and ceilings. Cleaning them with a bucket and sponge is slow, tiring and messy. People will welcome a service that does a professional job of cleaning quickly and without mess.

3 Von Schrader Detergers: each does on-location cleaning at its best

With Von Schrader Detergers—professional cleaning equipment—you'll do on-location cleaning that wins repeat customers . . . make as much money part time as many people earn full time . . . enjoy a steady, dependable business of your own . . . watch your income grow to where you are financially independent. Every home, every building, are a potential source of income.

You can start your on-location cleaning service with any one, two or all three Von Schrader Detergers.

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Wall Deterger. Washes walls and ceilings 6 times faster (and better) than the



Von Schrader Carpet Deterger. Cleans so completely it helps restore natural beauty. Fast drying.



Von Schrader Upholstery Deterger. Gives deep-level cleaning to fabric upholstery and synthetics.



Von Schrader Wall Deterger. Washes walls and ceilings 6 times faster (and better) than hand method.

bucket-and-sponge method. Cleans easily without any mess.

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Upholstery: "One day I did a \$135 job. Best week was \$500."—C. Lambert. "We passed over the \$450 mark in five days."—T.E. Baylor

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NEW YORK—Imagine communities without smokestacks! This prediction by Maj. Alexander P. de Seversky (designer of World War II's P-47 fighter plane), now president of Seversky Electronatom Corp., followed his design of Hydro Precipitrol, a precipitator which controls stack emissions (sulfur-dioxide or nitrous oxide) and recovers by-products (sulfuric acid or nitric acid) marketable to fertilizer plants. It operates as follows: Exhaust gases enter the bottom of the precipitator and flow upward where gases are ionized and collected by electrodes, liquid in form. The liquid with particles then flows downward to a sump where entrapped particles become by-products while the liquid recirculates. Hydro Precipitrol has already been installed (January) at the General Battery Corp. in Laureldale Township, Pa.

ALBANY, N.Y.—Preserved fish caught up to 43 years ago and recently studied at the New York Department of Environmental Conservation at Albany have been found to contain more than twice as much mercury as that in fish currently banned from the market. Blue pike (caught in 1939—Irondequoit Bay, near Rochester) had the highest concentration of mercury—1.03 parts per million—of the old fish studied. To learn just how widespread this situation is, Henry L. Diamond, department commissioner, has asked collectors of old preserved fish to contribute their fish to further research. Write to Comm. Henry L. Diamond, New York Department of Environmental Conservation, Albany, N.Y. 12207.

CHICAGO—Virtual elimination of black diesel exhaust smoke has been found to result from the addition of a barium fuel additive. (The Von Brand smoke recorder and a Clayton dynamometer were used in measuring.) The importance of such an additive cannot be emphasized enough when considering that excessive exhaust smoke is the basis for most state and city antipollution regulations. A manufacturer of one additive, Ever-Tops NS, is Robert J. Kerr, Inc. 6600 N. Ogallah St., Chicago, Ill. 60631. The additive also promotes engine cleanliness, extends injector life, reduces engine and ring wear, and improves power and mileage.

WASHINGTON, D.C.—Five patents were recently given to the Union Carbide Corp. for its Unox pure-oxygen process for treatment of sewage. Like conventional processes, Unox also introduces oxygen into sewage activating bacteria to decompose wastes. But, because Unox uses pure oxygen, decomposition is faster. So, the system will be installed at the Newtown Creek waste treatment plant in Brooklyn where the pollution problem is not only municipal sewage, but also, pharmaceutical and brewery outflows.

DO YOU KNOW about some action being taken to fight pollution that we don't know about? In your community? On the job? Tell us about it. Write Environment Editor, Popular Mechanics, 224 W. 57th St., New York, N.Y. 10019.

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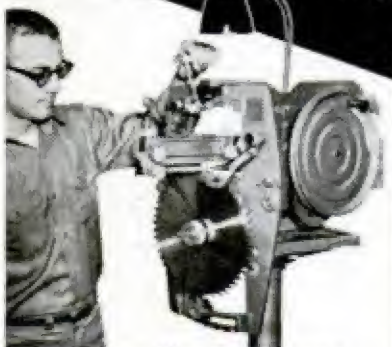
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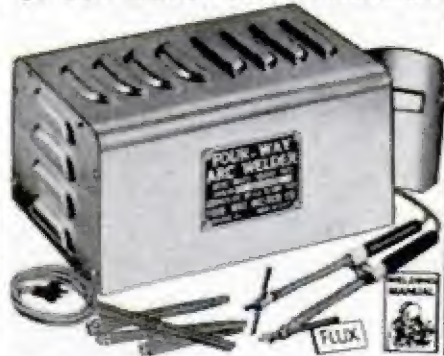
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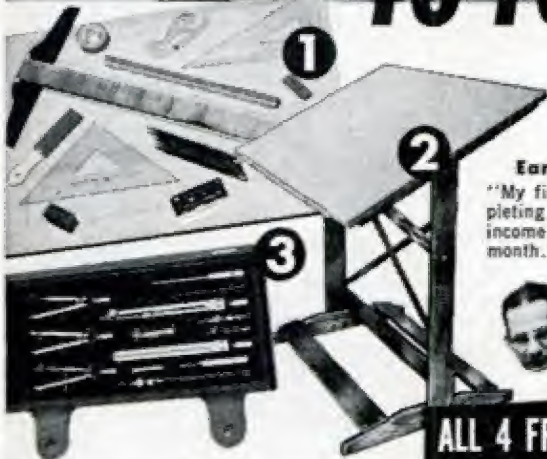
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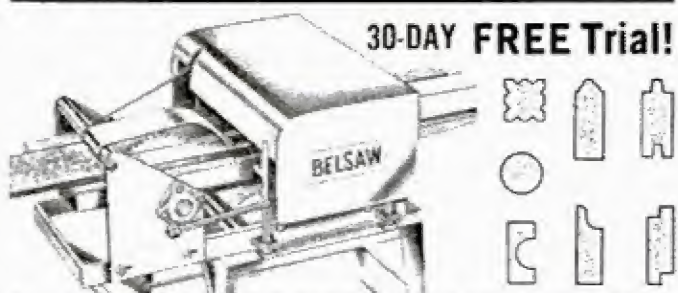
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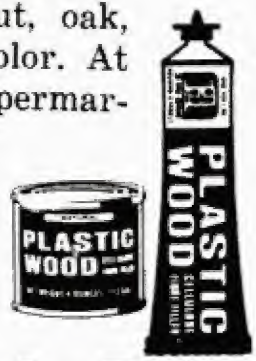


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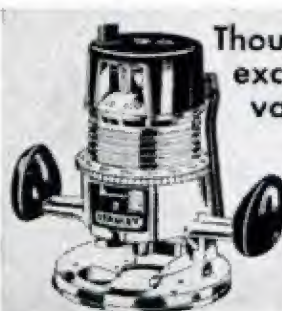
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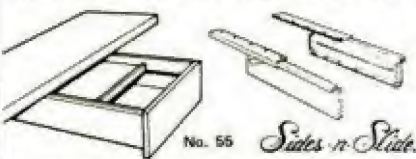
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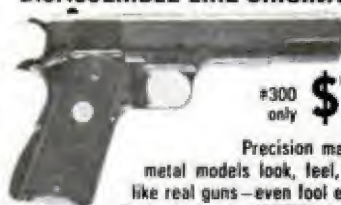
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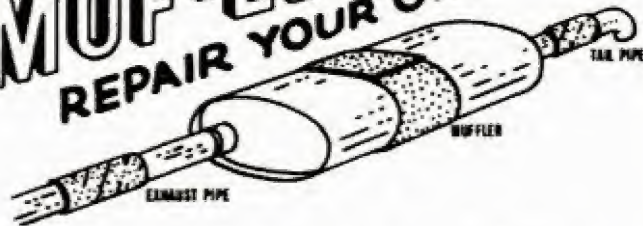
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Sportwin has 16 quick-trim positions — eight for running in weeds and shallows — and eight for fitting hard-to-fit rental boats.

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The motor is isolated on rubber mounts, so fish-spooking vibration isn't transmitted by the boat. It's so smooth and quiet when you're trolling, you may wonder whether it's even running.

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ON-THE-GO

CAMPING

BY V. LEE OERTLE

CASINO-STYLE RV RESORT COMING! Camper Ranches, Ltd., has acquired a former casino in Las Vegas, Nev., and is transforming it into the first gambling RV resort. Paved campsites by the casino, shops, baby-sitters, and mechanical services are expected to lure the RV traveler who wants to gamble. Rates are tentatively set at \$50 a week or \$10 daily. Camper Ranches, Ltd. (Box 4507, Las Vegas, Nev. 89106), is also adding other parks to its chain in Idaho, New Mexico, Florida, California and in Sonora, Mexico. Preregistration is said to be necessary to gain entry.

BE FUSSY ABOUT RV INSURANCE. There's a great difference in benefits offered by various insurance companies. Some companies view a trailer, camper or motor home as a higher-than-average risk, while others treat RVs with preferred-rate premiums. Be sure to ask these key questions: Does the insurance cover personal effects within the insured unit? Is it guaranteed renewable? Does it provide coverage while the coach is separated from the towing vehicle? Does it provide special payments for on-site fire department service, or for emergency expense allowances when you're involved in an accident far from home? New RV policies are available. Shop around!

GOLDEN EAGLE POLICY ESTABLISHED. The Golden Eagle Passport, an annual permit for use at public recreation sites operated by the National Park Service, Bureau of Sport Fisheries, Bureau of Land Management, U.S. Forest Service and Department of Agriculture, went on sale last Dec. 15, for a new annual fee of \$10. It is valid Jan. 1 through Dec. 31, 1971.

NEW SADDLE-TYPE CAMPER FOR BRONCO. The world's first overcab camper coach for a 4x4 Bronco station wagon was recently unveiled for *Popular Mechanics*. Called the Hi-Country Camper, the incredibly compact unit rides on the back and top of a 1971 Bronco wagon. It contains two bunks, fully-equipped kitchen and even a toilet compartment. All this luxury fits into a package small enough to attach or remove in 5 minutes, weighing under 500 pounds and costing well under \$1000. Details from Hi-Country Campers, Ber-mack Industries, Box 168, Whittier, Calif. 90603.

WARNING: INSURANCE COSTS ROCKET ON RENTALS. One rental dealer told us privately he must now pay \$60 per season to insure each tent-trailer he rents. Because some rental agencies carry as many as 100 units at the season's peak, insurance is a critical expenditure. As a result, rental rates will doubtless be higher this year.

Some dealers just "take a chance" and rent *without* insurance. Renters of units damaged while in their possession could be stuck for repair or replacement costs. Insist that the rental agent explain all insurance provisions. One camping family lost a rental tent-trailer when a cheap bumper-hitch broke. The dealer sued and made them pay. The bumper-hitch was inadequate; hence, negligence could be charged. Get insurance provisions written into your rental form!

CHEVROLET HAS CREATED SEPARATE RV DEPARTMENT to handle RV development and promotion in a bid to wrest the spotlight from Ford and Dodge. Most newsworthy in the announcement from GM was that it "will maintain close liaison with all recreational equipment companies to keep abreast of their present and future requirements for adapting our vehicles to recreational use." Chevrolet's past attitude has sometimes been: "Make use of what we offer." Now it's saying it will custom-build units for special coach duty. That's good news indeed. Head of the new department will be Herb Henry.

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HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

Laying a brick walk

I'd like to lay a brick walk without mortar from my front door to the sidewalk, about 30 feet. Inquiries bring varied advice about how to lay the bricks—lengthwise, crosswise or in a "herringbone" pattern. Can you give me an authentic go-ahead? Is there any preparation other than digging a trench that's brick-thickness deep?—N.H., Nev.

It depends on the soil, the slope (if any), drainage and the kind of bricks you use. For bricks laid "dry," that is, without mortar, you will need to trench at least 3 inches deeper than the thickness of the bricks and then tamp in gravel or crushed stone to a depth of at least 3 inches (4 or 5 inches if the soil tends to be at all unstable). Normally the bricks should be laid lengthwise with the run of the walk, but you can use any pattern that suits your fancy. In any case the edges of the trench must be cut straight so that they serve to hold the bricks in place. In time these bricks will settle, so keep the top of each one slightly above the level of the sod as you lay them. There's no special problem other than keeping the bricks uniformly level as you go. In some cases such a walk is crowned slightly; in others a line of bricks is laid on edge on each side before filling in. This latter step tends to keep the walk from settling unevenly.

Carpeted basement floor

I'm building a small home by myself. I have the basement in, first floor laid and temporary roof on. I'll live in the basement for a year; it's dry—no seepage or flooding. Temporary partitions divide the space into three rooms. I want to carpet the largest as a "living room." Later it will be the rec room. Is this practical? What carpeting should I use?—W.S., Ark.

You might use the new indoor-outdoor carpeting. I would want to be very sure there is no seepage, that flooding is extremely unlikely, and that the floor is absolutely clean and smooth—no dusting, loose material or ridges. I also would coat the masonry foundation walls—block or poured concrete—with a masonry water-proofer and, if necessary, provide adequate ventilation with a small fan installed

in a window. Indoor-outdoor carpet usually is supplied as squares to be cemented or taped to the floor like tiles.

Outside paint problems

You're doing a creditable job of answering questions, but I disagree when you imply that common outside paint problems—blistering and peeling—are due to moisture coming through from the room side. I say that in many instances paint problems are caused by heavy dew and rain filtering into tiny cracks that develop in the paint film, enlarging these breaks and eventually causing the paint to crack and peel. The tiny cracks generally are caused initially by expansion and contraction of the wide, softwood sidings now commonly used. Right?—T.D., Md.

In saying that peeling and blistering are due to moisture coming through walls from the room side I did not mean to imply that all paint problems are due to this cause. Prevailing winds, latitude, location of shade trees and adjacent structures expose painted siding to differing "climates" on sides and ends of any dwelling.

Wide, softwood sidings do shrink and expand with periodic changes in temperature and humidity. Though slight, these variations can cause stresses on the paint film often resulting in fine cracks along the grain. Shrinkage usually causes breaks, or "upsets," in the paint film along the length of the board, resulting in tiny ridges in the form of inverted vees. Eventually these widen and the loose strips of paint fall away, exposing the wood to moisture absorption. Edges of the narrow opening thus formed often loosen and curl. This is especially difficult to deal with by sanding or scraping. Usually it's advisable to take off the defective paint film to the bare wood with a chemical remover. Or, you can remove all the loose material and fill these narrow breaks with spackling compound, sanding it smooth after it has hardened. I don't know that this is an approved practice, but I have done it successfully.

Attaching ornament to brick

How can I attach a fairly heavy cast-iron eagle ornament to the brick above my fireplace mantel?—J.M., Ga.

Perhaps the best way is to make a hole about 3 inches deep in a mortar joint with a star drill, then drive in a slightly oversize dowel. Drill the end of the dowel and turn in a roundhead screw to nearly full depth. Hang the eagle from the screw, centering it to hang level. ★★★



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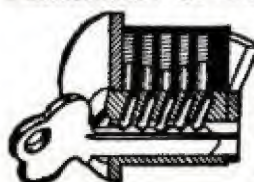


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POPULAR MECHANICS

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SOLUTIONS FOR MECHANICAL HEADACHES

AUTOMOBILE CLINIC

BY MORT SCHULTZ

Rear-end clunk

The rear end of my 1970 Ford truck gives out with a "clunk" when I start off. The service manager says that most Ford trucks are doing this because rear springs are weak and letting the rear end shift up and down. Is he putting me on?—Caron Hotchkiss, Waycross, Ga.

In many cases, the clunk is caused by dirt on the driveshaft splines and lack of lubrication. Tell the dealer to pull the shaft, clean the splines carefully and lubricate them as specified in the car's lubrication chart.

Vibrating shift lever

My 1969 Valiant's stick-shift lever on the steering column jumps up and down, and makes a racket. It is very bad when going over bumps. Can you help me?—E. M. Bowlby, Trenton, N. J.

They all do this to some extent, but if the condition is bad enough to cause "a racket," there is a mechanical reason—like a broken transmission mount or misaligned steering column.

Gas in oil

I have a 1959 Chevrolet Six that's drawing gasoline into the oil. My mechanic has changed the fuel pump twice, overhauled the carburetor and replaced the manifold without success. Where do I go from here?—Leo Tucker, North Hollywood, Calif.

Clean out the crankcase ventilation system to assure good airflow. This should include the valve cover air inlet breather and road draft tube. There are metallic screens in each of these that can become dirty and restrict airflow, which would cause internal pressure, forcing fuel past rings and into the oil. Naturally, with a car this old, there is always the chance of piston and piston ring wear.

Should she downshift?

I would appreciate your opinion on how to descend these steep Connecticut hills in my Volkswagen. My husband says to shift to second gear. My brother-in-law says brakes are cheaper to replace than a

transmission and I should depend solely on foot braking. To whom should I listen?—Mrs. Olga Buttrick, Watertown, Conn.

Your husband and the VW owner's manual which states that when descending a hill you should make full use of the engine's braking power by selecting a lower transmission range. You won't hurt the transmission by using it for a purpose for which it's intended. Just don't select too low a gear and over-rev the engine.

Can't adjust brakes

The adjusting mechanisms for brakes on the Oldsmobile Toronado are out of sight of the slots in the drums. Is there an offset tool I can buy to make this adjustment?—H. G. Thomsen, San Francisco.

No. These are self-adjusting brakes and, theoretically, you shouldn't have to adjust them manually. However, self-adjusting mechanisms can freeze because of dirt and rust—the main reason why auto manufacturers recommend that you exercise self-adjusting mechanisms every so often by backing the car up and applying the brake pedal. If mechanisms in your car have frozen, you will have to pull the drums, free the mechanisms, and lubricate them and the brake guides.

Ford's I-beam headache

I and other people have the same problem with the 1969 Ford Club Wagon—trying to get the right front tire to last more than 6000 miles. Several trips to the dealer and phone calls to Ford's regional office have not led to a solution. I am at my wit's end and, if I could afford to, I would get rid of this vehicle. Ford surely didn't have a better idea making twin I-beam suspension.—John Decker, Paterson, N. J.

I took this one to FoMoCo, which claims the problem will probably be overcome if you adjust toe-in exactly to the specification outlined in the shop manual and rotate tires. I realize this appears too simple, but it's worth a try. If it doesn't work, there's another solution I've heard of: Replace the front springs with a heavier type—part No. C8UZ-5310-F for the left side

(Please turn to page 70)

When your kid starts telling you what oil to use, listen.



He may be your kid. But that's no kiddy-car he's driving: a 390-cube, 4-barrel V-8, four-on-the-floor muscle machine he has purring like the family kitten.

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The 1971 Buicks are waiting for you to test-drive now.

Pictured below are the new Buick LeSabre (left) and the Buick Electra 225.

1971 Buick. Something to believe in.



AUTOMOBILE CLINIC

(Continued from page 66)

of the car and part No. C9UZ-5310-A for the right. Then, bend the twin I-beams until front-end alignment is brought into proper spec.

To preserve tires

Is there something I can put on tires to preserve them? I don't mean tires that are on the go every day, but those on trucks and farm machinery which stay out in the open and stand idle for some time.—Richard Johnson, Geneseo, Kans.

If there is a worthwhile tire preservative, I haven't heard of it. I guess that you are noticing little check marks on the sidewalls—so-called weather checking. The only thing I can recommend is that you keep tire pressure up to normal, jack up the wheels and slip boards beneath the tires. Allowing the tires to rest on boards will protect them against the freezing and thawing of the ground.

The hot one

I have a 1965 Pontiac GTO that has the three two-barrel-carburetor setup. No matter what I try, including carburetor rebuilding, the center carburetor runs rich. I've spoken to many people having this arrangement and they have the same problem. The car runs okay, but isn't as responsive as it should be. Is there a solution?—Jay Keller, Reserve, La.

No. This is the way it is with the three two-barrel setup; the engineers have yet to find a solution. One carburetor, nearly always the center one, has more heat concentrated on it than the other two simply because of its position in the engine compartment. Heat causes the carburetor to overload. Not even smaller size jets will help.

Jumping hood

When I hit a bump, the hood of my 1969 Chevelle Malibu jumps open. Fortunately, the safety latch keeps it from flying up. The bolt has been adjusted a few times, but this hasn't helped. What should I do?—Meyer M. Katz, Brooklyn.

This is what happens when guys at the

gas station get overzealous when closing the hood. They bend the bolt. You have two choices: move the striker plate in the radiator grille or replace the bolt.

Service Tips

If you have recently purchased motor oil and have examined the can, you may have noticed some strange letters you've not seen before—SD, SC, maybe even SB. This is a new way of identifying what an oil is intended to do. It replaces the MS—MM system with a graded system that specifically establishes performance levels. Here's what the letters mean:

● **SD.** Oil bearing this classification on its can, which means that the oil is for service class D, tells you that it has been refined to meet the requirements of automobile manufacturer warranties for passenger cars beginning in 1968. If your car is under warranty and you use any oil other than SD (or MS), you will void your warranty. This oil provides the greatest protection you can get against high and low temperature, wear, rust and corrosion.

● **SC.** Oil bearing this classification is refined to meet the requirements of auto manufacturer warranties that covered the 1964 through 1967 models. It provides protection against temperature, wear, rust and corrosion, but not to the same degree of protection afforded by SD.

● **SB.** Oil intended for service class B is for use in engines which are operated under mild conditions and need minimum protection. This oil provides only anti-scuff capability, and resistance to oil oxidation and bearing corrosion. Naturally, an oil designated SD can be used where oil designated SB or SC is suggested.

● **SA.** This isn't suited for automotive engines. No performance requirements for service class A oils have been established.

Although these new designations are in existence now, for the next year anyway you will still encounter oil cans having the MS and MM classifications. MS means that the oil is designed for severe motor service—stop-go driving, short trips, and long periods of idle as well as high-speed operation. MM means that the oil is designed for moderate service—where there is little stop-and-go, short-trip and long-idling driving. ★★★

GOT A PROBLEM WITH YOUR CAR? Ask Mort about it. Send your question to Auto Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of general interest will be published in the column.

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Ralph Wise calls on the same craftsmanship making our country Bourbon as he does refinishing this antique table. For a set of refinishing plans, write: Old Crow, Box 675, Frankfort, Ky. 40601.



Soften table's old finish with remover. Scrape. Use toothbrush to get at crevices.



Wipe wood with fine steel wool soaked in paint remover to avoid scratching. Sand.



Stain. The trick is to follow the grain, use long strokes, work fast.



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Made by good Kentucky hands

KENTUCKY STRAIGHT BOURBON WHISKEY. 85 PROOF. DISTILLED AND BOTTLED AT THE FAMOUS OLD CROW DISTILLERY CO., FRANKFORT, KY.

Mr. Victor suggests a much longer cigarette to go with his new hairstyles.

Now everybody will be smoking longer cigarettes to go with their new hairstyles

...almost everybody.



Camel Filters.
They're not for everybody.
(But then, they don't try to be.)





It Protects the Surface From Six Miles Up!

You spell it AWACS—an eight-engined 707 with enough radar, radio and computers to boss a whole battle.

By MERLE E. DOWD

THOUGH IT SOUNDS like something you might polish your car with, it's designed to polish off an enemy. AWACS (pronounced a-wax) stands for Airborne Warning and Control System. It's a flying nerve center—a big jet crammed with the most complex package of communications, display and computer gear ever assembled in a single plane. And it's a full-scale radar station that can operate at 30,000 feet.

AWACS is the Air Force's newest defense system. In its tactical role, it will provide a commanding officer with the best "view" any general ever had of a battle.

From its sky-high position, AWACS monitors the progressing action (see illustration on the following two pages). Radios crackle; an artillery man relays a call through AWACS for an air strike against a stubborn mortar position. Radar picks up a flight of enemy attack fighters as they streak through the hills 100 miles away. As

radar and computers vector the fighters' position, a signal scrambles an interceptor squadron to surprise the attackers. An urgent radio message calls for an air-evac helicopter to pick up wounded. Infrared sensors locate enemy troops infiltrating along a supply route. An observer pinpoints the position and calls for fighter-bombers. Following a tip from an AWACS observer, fire-belching gunships attack a band of guerrillas waiting to ambush a convoy. Navy attack-bombers appear on an AWACS screen as they catapult from carriers off the coast and assemble for a low-level strike at coastal defenses.

Communications form the hub of AWACS activity. Radio, TV, infrared and other sensors, and the all-important radar flood displays and earphones with information as AWACS loiters above the battlefield. Radar blips constantly update map displays. Signalmen hunched over cathode tube (CRT) display consoles or seated with

AIR FORCE
FIGHTER-BOMBERS
PROVIDE
GROUND SUPPORT

MARINE FIGHTER
PLANE COVER

MAIN SUPPLY ROAD
BLOCKED BY ENEMY AMBUSH

U-2 HIGH-ALTITUDE
RECONNAISSANCE PLANE

PUFF THE MAGIC DRAGON
SUPPORTING A BESIEGED
U.S. MARINE PATROL

TACTICAL INFANTRY
PARACHUTE ASSAULT

ARMY
HELICOPTER
GUNSHIPS

AMPHIBIOUS
LANDING

ENEMY INTERCEPTORS

HELICOPTER,
INFANTRY
ASSAULT

ENEMY ROCKET BATTERY
UNDER AIRCRAFT ASSAULT

ENEMY MECHANIZED ATTACK

FIGHTER GROUND-SUPPORT MISSION

headphones in front of maps relay messages back and forth among walkie-talkie-equipped ground troops, field commanders, attack aircraft in the area, and naval gun batteries offshore.

Great gobs of data pour in. The officers aboard AWACS know more about developments on the ground and in the air than any commanders ever knew before—and while it is all happening.

SUB RECON MISSION

B-52
BOMBING
MISSION

U.S. SHIPS MOVE
TO NEW POSITION

NAVY FIGHTER PLANES TAKE
OFF ON INTERDICTION MISSION

TROOPSHIP WITH
MEN FOR ASSAULT

AMPHIBIOUS
LANDING

FIGHTER GROUND-SUPPORT MISSION

AIR-CUSHION
VEHICLES

ARMY INFANTRY PATROL
REQUIRES ARTILLERY SUPPORT

So that land and sea action could be portrayed, the battle scene by artist Ed Valigursky shows AWACS at a much lower altitude than it would normally operate

In its air-defense role, AWACS will extend radar surveillance hundreds of miles beyond U.S. borders. The Air Force doesn't say just how far. In times of low tension, AWACS picket planes could remain on ground alert. OHR-B (Over the Horizon Radar—

Backscatter) monitors could pick up bogies approaching. A signal would scramble the AWACS crews. Once airborne, AWACS immediately enlarges its area of surveillance as it speeds to its lookout station. During periods of high international tension, AWACS would remain on airborne alert.

Dual-purpose equipment will permit

(Please turn to page 198)



On narrow road through redwoods at Navarro, Calif. rack and pinion steering inspired confidence.



Crossing to Vancouver Island, B. C. Pinto compactness was an asset getting the last berth.



Windy Oregon coast has warnings; Pinto is easy to hold



Both cars agile on San Francisco's steep hills



With 4834 miles on Pinto, I switched to Vega at home of PM's West Coast Editor



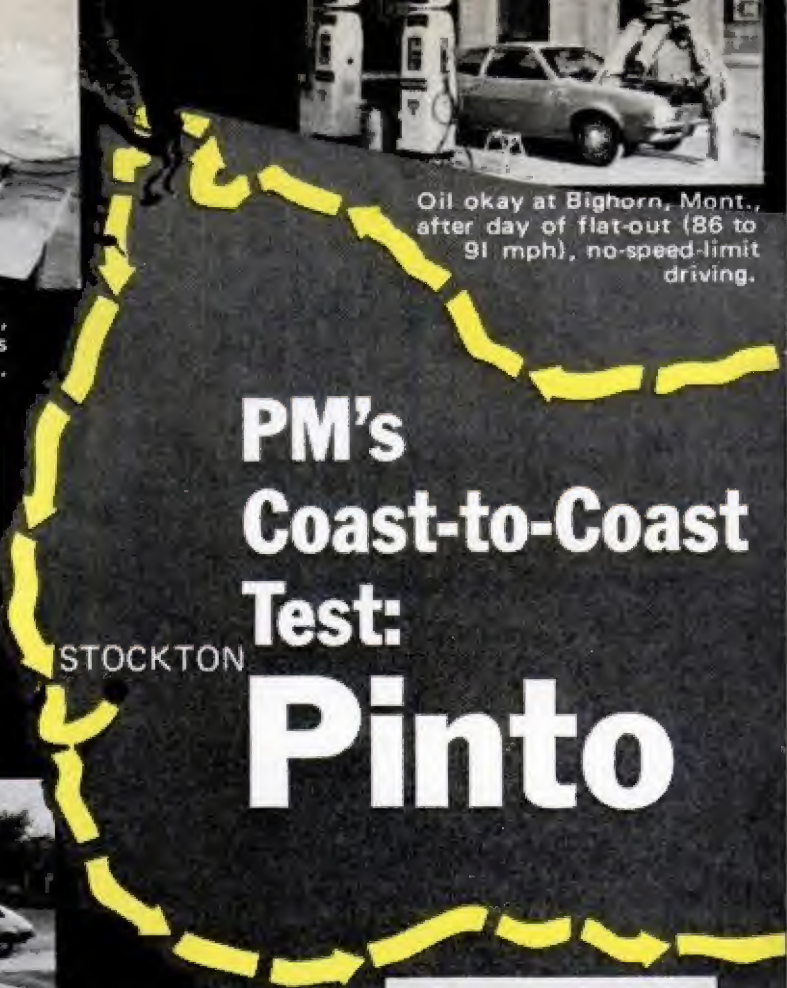
Ran out of gas in Monterey!



Rest stop. Jackrabbit, Ariz.



Oil okay at Bighorn, Mont., after day of flat-out (86 to 91 mph), no-speed-limit driving.



PM's Coast-to-Coast Test: Pinto

Last October, PM sent Irv Dolin, automotive photographer and car buff, on a journey around this large country, driving first Ford's Pinto from New York to California, and then Chevy's Vega back to New York. Irv (whose expertise in long-distance test driving started several years ago when he co-drove a racing "bird cage" Maserati from New York to Florida) drove the Pinto to Stockton, Calif., home of Mike Lamm, PM's West Coast editor. There he "traded it in" for the Vega and finally, after a month and a half of living in the two cars, arrived in the East with some definite conclusions.

By IRV DOLIN

I PICKED UP THE PINTO at a Ford garage in New York and started home to pack it for the long trip ahead. I thought, "It looks like an American car outside, but inside it has the feel of a small, imported sedan." Smart bucket seats, instruments and controls were well positioned—with one glaring exception: The dimmer switch is way up on the left side of the firewall. Very awkward. In fact, the first time I tried to use it I couldn't find it!

I found the driver's seat a bit low, but a thin cushion put me up where I

POPULAR MECHANICS



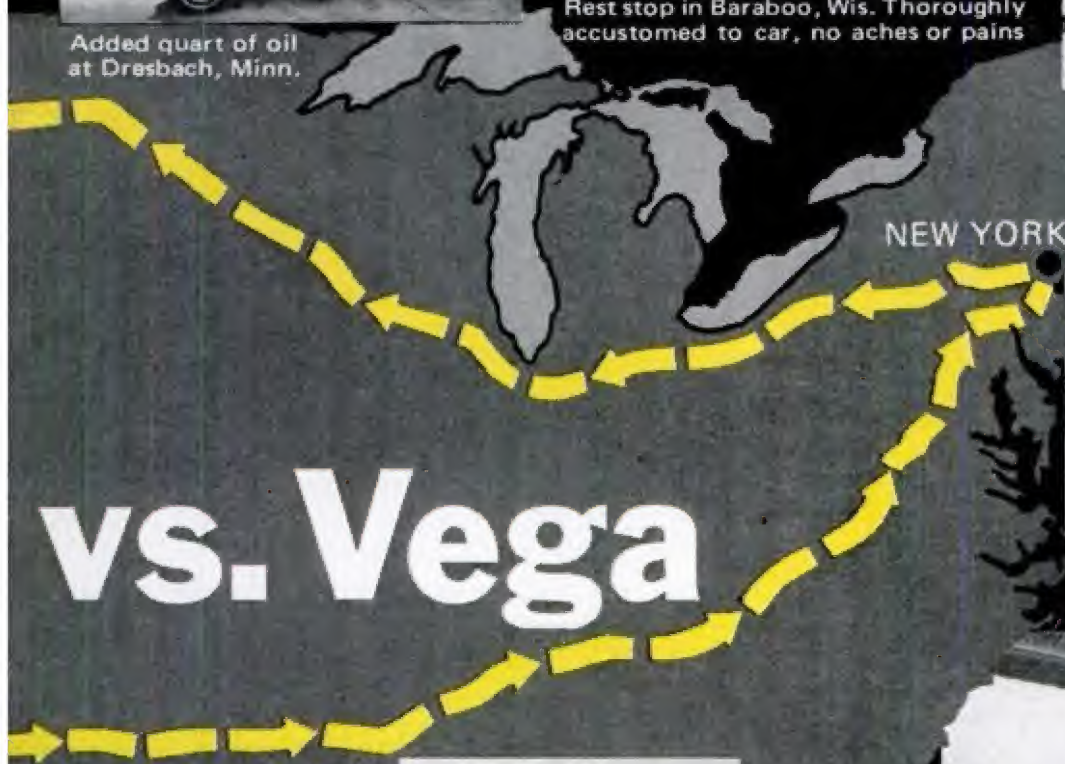
Added quart of oil at Dresbach, Minn.



Rest stop in Baraboo, Wis. Thoroughly accustomed to car, no aches or pains



First overnight stop in Pa., stressed need for very organized luggage stowing; trunk opening is narrow.



NEW YORK

vs. Vega



In New York City, Pinto is ready to go—gas, lubricants topped off

In Shawnee, Okla., Vega styling praised as usual



Suspension shocks get back to the driver on both cars



Back in New York with 4806 miles on Vega. Used only 1/3 quart oil!



Passed Vega coupe on U.S. Rt. 70 near Rockwood, Tenn. Saw few because of GM strike. Car cruised at high speeds effortlessly.

wanted to be. The moderate fastback affords a little less rear visibility than I like but it's very good compared to Ford's bigger fastbacks.

The Pinto's trunk has no mat. With all my gear I needed some sort of padding to keep rough edges and the wingnut that holds the spare from scratching my bags. A large quilt solved the problem. Because of the narrow trunk opening, the trunk seemed smaller than it actually is. Still, it's not huge; a couple or a small family will find storage space inadequate on long

trips. I used the back floor and seat for some things. For its overall dimensions, though, the Pinto does pack quite a bit.

I've encountered a lot of American cars that have been sloppily put together: loose chrome, ragged carpets, bent moldings, screws in askew. But on this Pinto there was none of that. I'd have to rate it high on workmanship.

Before I got off poorly-paved Manhattan Island, I discovered that potholes are the Pinto's worst enemy. A couple of moderate-sized washouts made the



VEGA FILLER NECK is inconvenient to use and the filler pipe angle allows spillage when topping off

rear suspension bottom with a jolt. By the time I neared Williamsport, Pa., 200 miles west of New York on Interstate 80, I had confidence in the stability of the Pinto at high speeds and in the wet. Disconcerting, however, until you get used to it, is its action when you go over small bumps or tar strips on a curve. Expect a little rear-end hop to one side.

On those long stretches through North Dakota and Montana the Pinto cruised comfortably—for a small car—at 70 to 75 mph. Noise level was respectably low (lower than Vega's, I was to discover). Gas mileage on these flat-out stretches dropped as low as 19 mpg—well below the trip average of 25.17. With a slight downgrade and a tailwind I got the Pinto up to 91 mph. This was tops, short of dropping it off a cliff. On the level top speed was in the mid-80s. The manual says it won't go this fast, but that's what the speedometer read.

Just west of Fargo, I looked at the fuel gauge and figured I could make it to Jamestown. Soon, the needle was sitting on empty and for the last six or eight miles I just prayed. Nothing was to be seen on the horizon. I held a steady 60 mph and watched the odometer—mentally subtracting the miles I'd have to walk if I ran out. At last, a gas station! I rolled in with a sigh. We filled the tank to the very top, in-



A MORNING RITUAL was checking tire air pressure. I ran the fronts and rears of both cars at 28 p.s.i.

cluding the inside of the gas cap. The book says the tank holds "approximately 11 gallons." We got 11.8 gallons into it. (Later I ran low enough to get in 12.5 gallons!)

I found that driving fast—full-time work and fatiguing in any car if you're paying attention as you should—had a particular feel in the Pinto. Its rack-and-pinion steering is precise and responsive. It leaves no dead, sloppy play in the steering wheel when you're going straight ahead. And steering corrections due to wind gusts didn't need so much steering-wheel movement. You get a little aerodynamic buffeting from passing trucks on the interstates. Passing double trailer trucks on a two-lane road can be a genuine adventure because it takes a while to build up speed! On long grades, too, the Pinto slowly ran out of breath. In the Rockies I decided that if I lived there and were buying a Pinto, I'd go for the 90-hp engine. And I'd take the four-speed standard transmission over the automatic because I used second and third to good advantage on mountain roads.

I checked the odometer by highway mileage markers. Once for a distance of 50 miles I found the reading three miles high for every 100 traveled. All mileage and mpg figures have been corrected for this three-percent error.

Relaxing on the ferry from Victoria, B.C., to Port Angeles, Wash., I real-



ENGINE COMPARTMENT CHECKS were made often. Vega (above) used only one-third quart of oil on trip!



LUGGAGE STORAGE is tough in both cars—more so in Pinto, however. Luggage rack is a good option

ized that in several thousand miles, the Pinto engine had never skipped a beat, never fluffed and revealed no flat spots in its power curve. It also demonstrated good cold-weather starting, firing up without hesitation so you can drive right off with no coughing or bucking.

On the last leg down the Oregon and California coasts, I determined Pinto's 0-60 mph performance to be in the 18-second range. The gearbox, exceedingly smooth and a pleasure to use, contributes much to this respectable—for a 1600-cc Four—performance figure.

Test Cars—Specifications

	Vega	Pinto
Engine	4-cyl. Ohc	4-cyl. Ohv
Displacement	140 c.i.d. (2300 cc)	97.6 c.i.d. (1600 cc)
Horsepower @ rpm	90 @ 4700	75 @ 5000
Compression ratio	8.0:1	8.4:1
Transmission	4-speed manual	4-speed manual
Rear-axle ratio	2.92:1	3.55:1
Wheelbase	97.0 in.	94.0 in.
Overall length	169.7 in.	163.0 in.
Overall width	65.4 in.	69.4 in.
Shipping weight	2190 lbs.	2008 lbs.
Base price	\$2091	\$1919
Options on test cars	Interior and exterior trim group, 4-speed transmission, wide tires	Interior and exterior trim and protection groups
Price as tested	\$2337	\$2049

Fuel and Oil Consumption

	Vega	Pinto
Total miles driven	4806.3	4834.6
Average gas mileage	25.72 mpg.	25.17 mpg.
Oil consumption	1/3 quart	3 quarts

MARCH 1971

In Stockton I left the Pinto with Mike Lamm, PM's West Coast auto editor, and switched to the Vega which he had driven up from L.A. To my mind, Vega styling has it over Pinto's. With its optional wide tires Vega looks like a mini-muscle car. It also had a four-speed transmission which is optional on the Vega. I found its trunk bigger than Pinto's. But it, too, lacked padding and had plenty of sharp edges, so back went the quilt.

Our test Vega had a loose interior side panel beside the rear seat. I had to

Summary—Pinto

Likes: Good overall workmanship and finish. Good high-level and adjustable vents. Precise rack-and-pinion steering. Smooth gearbox and shift-lever linkage. Good cold-weather starting action. Respectable noise levels. Good economy.

Dislikes: Small trunk opening. Low, thinly padded seats. Poor headlight dimmer switch location.

Summary—Vega

Likes: Superior styling. Good acceleration and high-speed performance. Good economy. Good brakes (front discs standard). Good visibility in sedan. Roomy trunk.

Dislikes: Minor assembly defects. Slow throttle response. Poor headlight dimmer location. Poor gas-tank filler design. No glovebox. Fussy cold-weather starting. Appreciable engine noise.



FRONT ENDS OF THE CARS—the Pinto on the Oregon coast (left) and the Vega on U.S. 66 in New Mexico—are clean, uncluttered. In overall execution of styling theme, however, I definitely preferred the Vega

pound it back in place several times during the trip. The panels on the back of both front seats fit poorly and one of the shoulder-harness anchors was installed backwards so that the buckle pointed inward. After fixing it, I headed for San Francisco and quickly found the dimmer switch to be even higher on the firewall than the Pinto's. Again, the other instruments and controls are nicely laid out. I kept maps in the door pocket, which was handy. (The only glovebox is a small recess in the dash.)

In San Francisco, going down steep Lombard St., I had a "small" problem: The engine quit! It was the only get-out-and-get-under of my whole coast-to-coast-and-back trip. The ignition wire from the coil tower had come out of the distributor cap. The problem never recurred; the lead must simply not have been securely in place. The engine compartment is neat and clean, with everything accessible—even more so than in the Pinto.

Vega with a single-barrel carburetor is rated at 90 hp, and on the run down to the Monterey Peninsula its 0-to-60-mph performance shaved a second or two off the figure for the Pinto. Even so, Vega fuel mileage for the whole trip, 25.72 mpg, beat Pinto's 25.17!

Vega's gas gauge, tank and filler pipe

also had surprises. The tank is supposed to hold "approximately 11 gallons," like Pinto's. The most I ever got into it was 10.8. The filler pipe, behind the license plate on the Vega, is almost horizontal and gas slops out when topping off. After a few tankfuls, I figured out the peculiarities of the fuel gauge, which showed empty with three to four gallons left in the tank—more than a reasonable reserve. The Vega odometer was only 0.3 miles off in 100.

Driving in rain with windows closed, I found Vega's vent system defogs the glass a little slower than Pinto's. The high-level fresh-air vents in the Pinto also give better relief when the going is hot. Both heaters proved more than adequate in freezing temperatures.

Giving the Vega full throttle in the Southwest was exhilarating: It really pulls on long grades and has a top speed genuinely in the 90s. At one point I pinned the needle (over 100 mph indicated) trying to stay up with a Lamborghini. The noise level at high speeds wasn't bad, but Vega is a shade noisier than Pinto.

The Vega has recirculating ball steering and a loose, dead feeling in the center. Because of this it requires more of a wheel movement for response,

(Please turn to page 206)



Training wheels

Equipped with rubber tires rather than the wire wheels that it'll have on the moon, this lunar roving vehicle is the trainer U.S. astronauts use to prepare for a moon mission.



New van from Japan

Honda's new "Vamos," a small pickup van equipped with a 30-hp engine, is designed for agricultural and forestry work. Its price is slightly under \$1000.



Food warmer for Skylab

Each crewman in Skylab's Orbital Workshop will prepare his meals in a food tray like this. He'll simply put canned food in the recesses and flip a switch to warm it. The tray measures 13½ by 15 inches.



Fair share for little birds

Large birds (which often monopolize a feeder) are discouraged when they light on the tilting top of this one. Small ones don't tilt it, so they stay, finally descend to the tray to eat, says the Norwegian maker.

Renegade II

Painted in a color called "Big Bad Orange," trimmed in charcoal and equipped with padded rollbar, whitewalls and mag-style wheels, Jeep's new Renegade II is a limited-edition model based on the famed four-wheel-drive Jeep Universal CJ-5. Other standard features are rear-mounted tire carrier, V6 power and padded instrument panel. Factory-installed options include Bostrom rear seat, dual padded sun visors, heavy-duty springs and shock absorbers.



Coming: A Camera

By SHELDON M. GALLAGER

CAMERAS have been getting more and more automatic all the time, but until now you still had to do one thing yourself—focus the lens. Now Polaroid has come up with an electronic focusing system that even does this for you. Result: a camera so automatic a blind person could take perfect pictures with it.

Still under development, the ingenious camera “sees” your subject by means of sonic pulses from a miniature sonar-like transmitter. Mounted on top, like two protruding eyes, are twin transducer cones. One beams pulses at your subject; the other picks up reflected echoes. The time it takes the echoes to return indicates how far away your subject is. This generates a signal that drives a tiny servomotor geared to the lens, automatically setting the focus to the proper distance.

Because the focusing process is continuous, it will “track” a moving subject, keeping it constantly in focus. You just trip the shutter whenever you want and your subject will always be sharp. The system also lets you focus in situations where an optical rangefinder can't be used, such as in poor light or at night. Since it requires no light, it functions in total darkness.

How does the servomotor know how far to adjust the lens or which way to turn it? This is the really clever part. As the motor rotates the lens-focusing ring, it also moves a geared wiper contact along a variable resistor. The resistor produces a feedback signal that varies in strength according to the location of the wiper contact, thus indicating the position of the lens at any given moment. This feedback signal is compared with the echo signal from the subject through a bridge circuit. If it's greater than the echo signal, it indicates that the lens is set farther away than the subject. The servomotor then rotates the lens ring until the two signals are the same and cancel each other out. At this point, no current flows, the motor stops and the lens is in focus. If the feedback signal is less than the echo signal, it indicates that the lens is set at too close a distance. Polarity through the bridge circuit is reversed and the servomotor turns the lens ring in the opposite direction until the two signals match.

In addition to the self-focusing feature, the new camera will incorporate automatic exposure control and will take self-developing, instant-print Polaroid film packs. As yet, no date has been announced for its sale, but when it comes it will usher in an exciting new era of truly automatic picture-taking.

★★★

TRANSDUCERS
AND OTHER
ELECTRONIC
CIRCUITRY

BATTERY

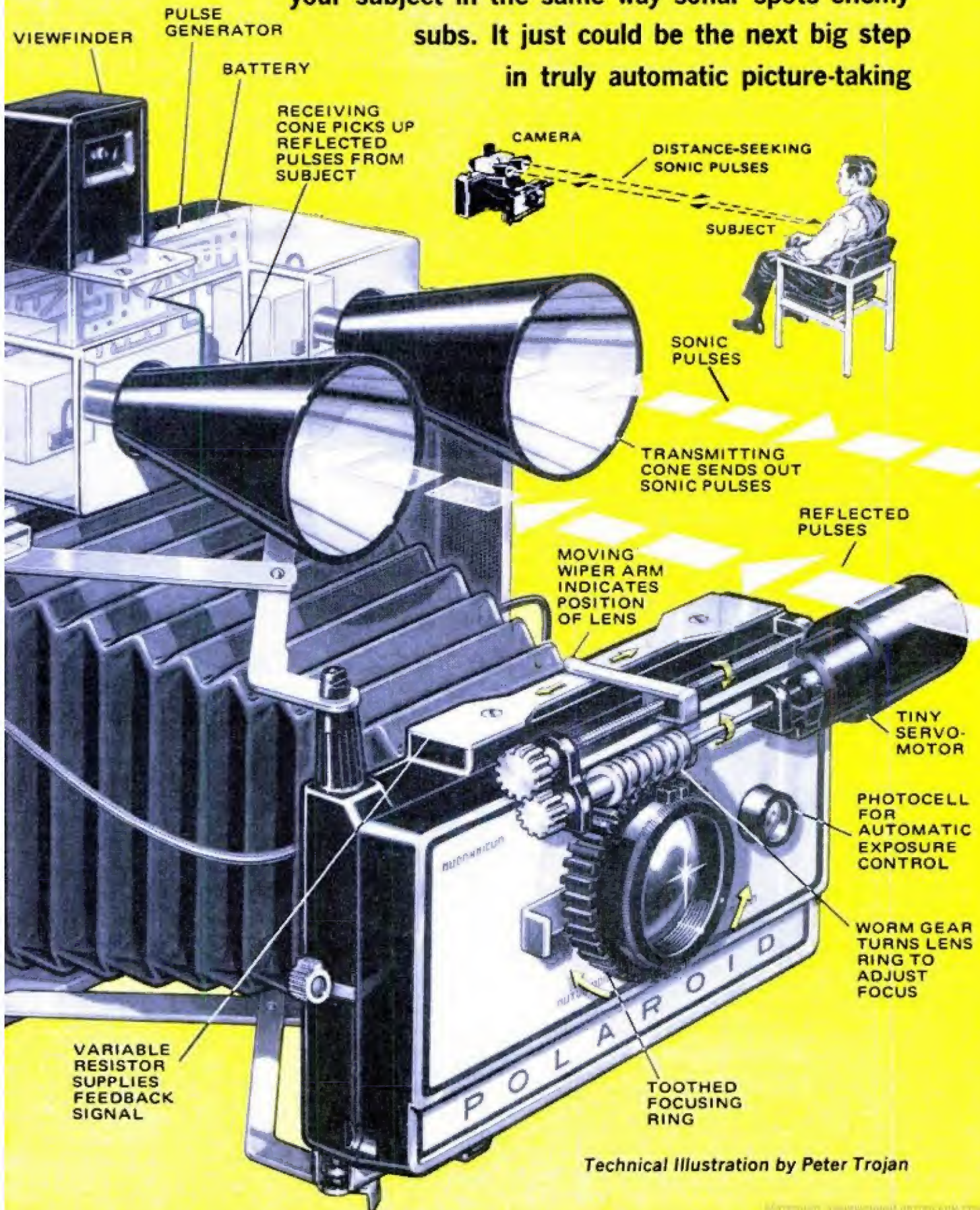
PUSHBUTTON
FOCUSING
SWITCH



COMPARTMENT
FOR POLAROID
FILM PACK

That Can Focus Itself!

This ingenious new Polaroid bounces sonic pulses off your subject in the same way sonar spots enemy subs. It just could be the next big step in truly automatic picture-taking



Technical Illustration by Peter Trojan



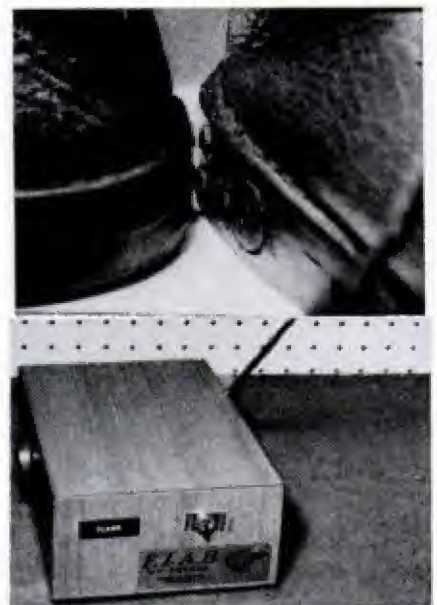
Facade of friendly faces

Putting people's pictures in their windows started as "conceptual art" but turned out to be a bit of effective social engineering, according to Peter Nemetschek, the artist who did it. He selected an apartment near Munich and convinced the residents not only to have their pictures taken but also to display huge enlargements in windows. Now the apartment looks better—and people who never spoke to one another before are firm friends.



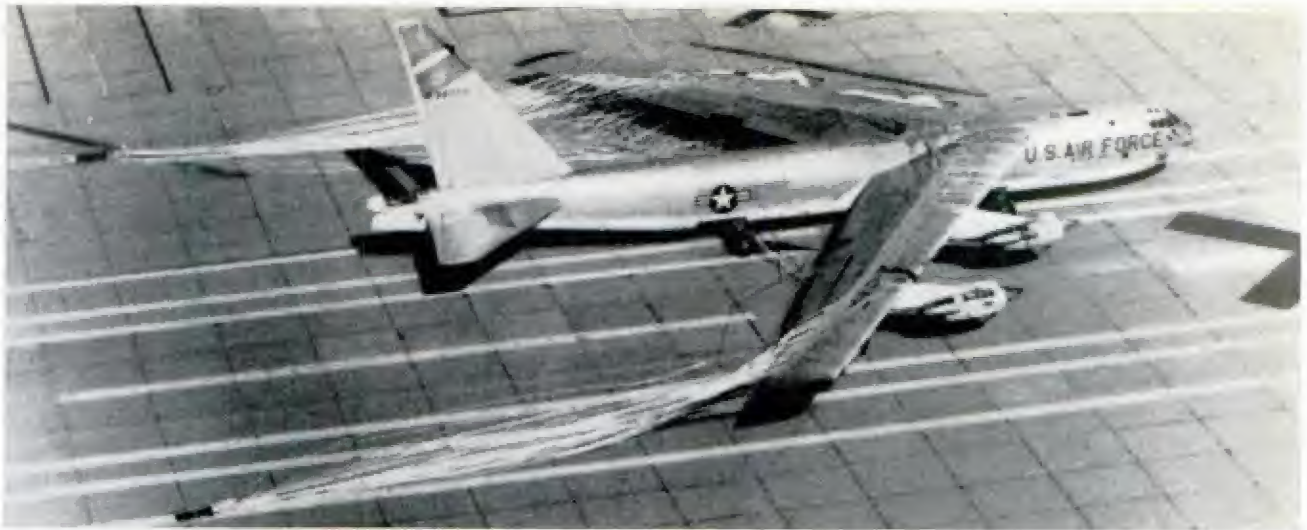
Supercritical wing for better cruise

A new shape in airfoils, the NASA supercritical wing, is shown here installed on a modified F-8 jet. Delivered to NASA by North American Rockwell, the new wing had shown in wind-tunnel tests that it could allow highly efficient cruise flight near the speed of sound (660 mph at 35,000 feet). In actual flight, it's expected to enable planes to cruise faster without an increase in fuel usage.



Heels call help

A pair of "alarm shoes" developed by an Italian doctor enable a bank teller—simply by bringing his heels together (top photo)—to send a radio signal that's picked up by a receiver (bottom photo) located within a 16-mile radius. Help can thus be summoned in event of a bank robbery.



Big net to catch big birds

On electronic command from pilot or control tower, a nylon barrier net pops out of a transverse runway slot and is held erect by pneumatic rubber tubes. A jetliner that has run out of runway on an aborted takeoff or too-fast landing is caught by the net, which wraps around the wings and brings the plane to a stop within 1200 feet. Two rotary hydraulic arresting gear (left), buried at either side of the runway, pay out nylon line as the net is dragged forward. Tests of the system, using a B-52, are being carried out at Edwards Air Force Base, Calif. The developers say the gear can even stop jumbo 747s.



Undersea lifter

An underwater "forklift," developed by the Naval Undersea Research and Development Center, can carry 1000-pound loads. The Buoyancy Transport Vehicle operates to a depth of 850 feet. It contains its own power, lighting and electrohydraulic propulsion systems.

MARCH 1971



Sure-footed speedster for ice

The Ice Cycle is a new recreational vehicle that zips along at 22 mph on ice. BGW Industries, Mansfield, Ohio, makes it.

"I'm retiring from driving,
 but... I'LL NEVER
 QUIT RACING!"
 Dan Gurney

Dan looks back at 15 years of competition in every kind of car, and looks ahead to managing the All American Racers team

PM: When Sterling Moss retired he said it was because he'd lost his reflexes. Freddy Lorenzen had an ulcer. Rodger Ward said racing had ceased to be fun. Do any of these reasons apply to you?

DAN: I suppose all could apply to a small extent. I wanted to do a job I was proud of whenever I raced, and it seemed as though I had less time to stay in shape racing and more responsibility with other things, such as being president of All American Racers.



WHAT A MOMENT for a team manager! Also for Swede Savage who won the Bobby Ball 150 for AAR. He's youngest driver to score a USAC victory

Do you feel you were actually slowing up or just not able to concentrate?

I think I was slowing up, but not necessarily because I wasn't able to go fast anymore. I just wasn't as sharp as I had been at one time.

How could you tell?

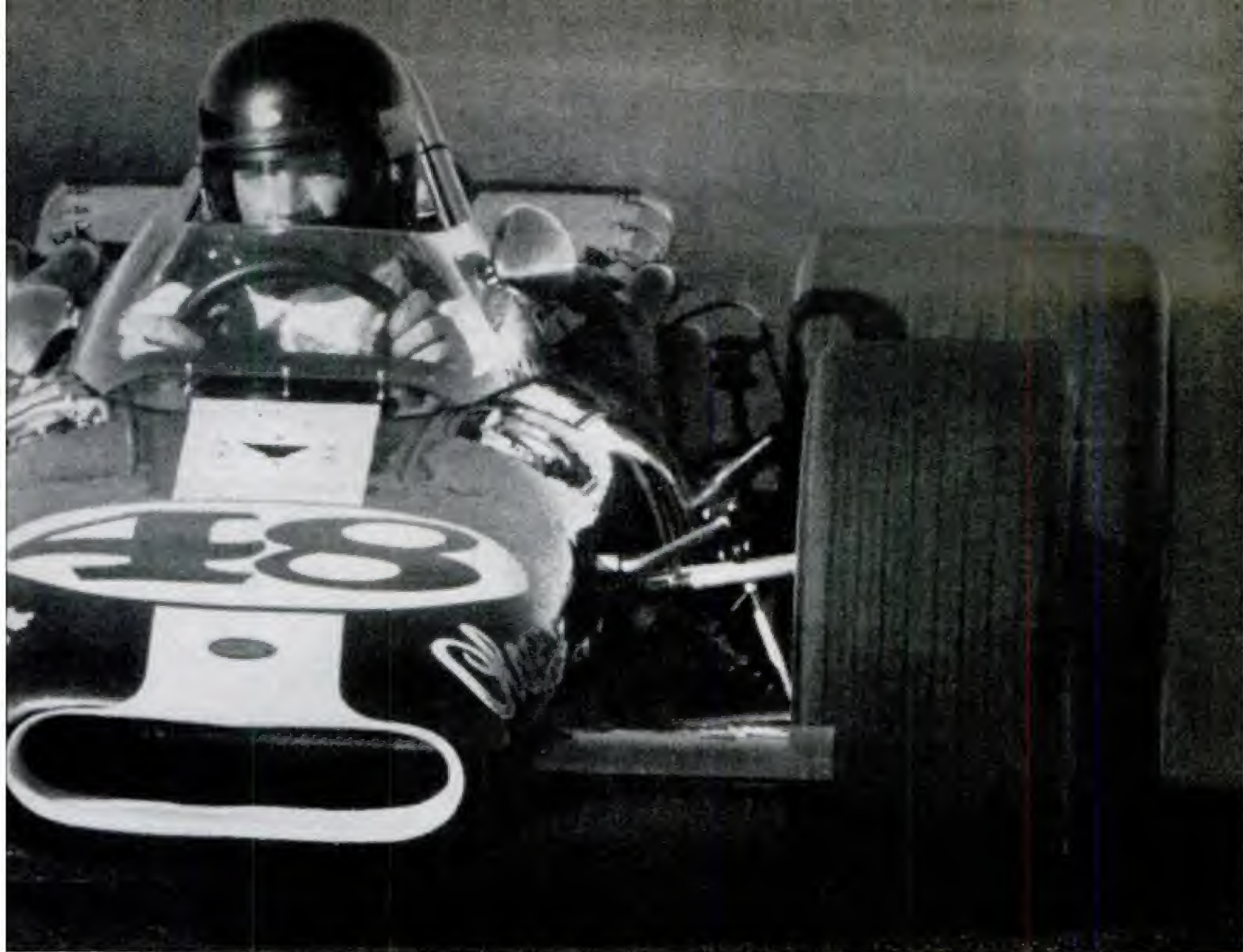
I was my own most severe critic and I knew when I felt right. The enthusiasm you need to generate the kind of dedication a race driver must have became more and more difficult to summon. I got older and my interests changed a bit.

Just how are you reappportioning your time?

Well, the main 1971 project for All American Racers is a two-man racing team. We're going to race the Indianapolis series of races—I believe it's 12 races including the Indy 500, the Ontario 500 and the new Pocono 500, July 3. Six will be on national television. It's also going to be the biggest circuit in terms of prize money.

You don't intend to do any guest shots

POPULAR MECHANICS



... if somebody calls you up and says, "Would you drive our Can-Am car next week?"

No, I intend to be deeply involved in racing but in a different way.

You used to say that you had two ambitions: to win the Indy 500 and to be World Champion in Formula 1. Do you feel frustrated that you didn't quite make either one?

From a driver's standpoint, yes. On the other hand, one must face disappointments. There's a lot of luck involved in winning the Indy 500. I've been second. I've been third. The second time I was second, Mario Andretti won the race. We were running at a speed for the last 50 or 60 miles that put me in reasonable striking distance, but neither Mario nor I was really *running*. Both of us were running about 10 mph slower than we should have been able to run. He was nursing his car along, and I was nursing mine. It really ceased to be a race. The pinion in his gearbox had one tooth gone and another that was cracked, yet I couldn't put on

any pressure because I had a whole lot of trouble myself.

Just how do you sense trouble with the car? How do you know when to back off and take it easy? Sounds, vibrations?

All of these. You can sense things beginning. For instance, you detect a foreign smell. Or you feel a vibration you know isn't normal. Or you sense a tiny miss or a change in the sounds or different amount of pull or a change in the handling of the car. When you're a race driver and you're running well you're extremely intimate with your car. It becomes an extension of your own nerves and feelings and all the things you use to sense what you're doing, where you are, how fast you're going and how close to the limits you are at any given moment.

Are you able to feel this way about a car you don't drive very often? You drove a Wood Bros. Mercury once a year. This year, you drove a strange Can-Am car two or three times. Do you get so you can "feel" them the way you do your Eagle that you

drive all the time or the Barracuda you drove in Can-Am?

That's a very difficult thing to do, but a good driver can gain a big percentage of this knowledge with a couple days of practice. But if you've been using your head, you try to look into other aspects: Who is preparing the car, what is its background, what its history has been, who designed it, who built it, what it's made out of, just how much strength it has, how hard you can push it, what sort of punishment it will take without falling apart.

Is it true that a good driver is apt to get a new car, a good car, a car built by a good car builder whereas a second-rate driver is apt to take a car that's been around or has been beat up?

Yes, a lot of the time second-rate drivers will take such a car because they don't have any choice. But I think they may be too easily satisfied. In the evolution of racing cars there've been a lot of small steps in improving the cars. Teams try to protect new-found knowledge, regardless of how they found out about it. "Speed secrets" is a good term for want of a better one.

Are you talking about a technique or a piece of mechanical equipment?

No, this is something that makes the car easier to drive. A suspension improvement or any small thing. A driver might say,

"Well, I feel pretty good today," and he'll even have his mechanics thinking, "Now this guy's really something great," when in fact, regardless of how great he is or isn't, the reason is that *they've* done something that's a little bit better mechanically. If a lot of second-rate drivers were not so easily satisfied, they would find out about the subtleties of sensing car setup.

Why is it in this mysterious area of "speed secrets"—setting up a car (suspension mainly)—that no scientific formula has evolved so anyone can set up a car to handle it through the turns at maximum speed?

Well, we have been working on this, and it's one thing I think you'll see coming about. I mentioned this "speed secret" thing, and I think that that explains it right there. If someone were to come up with the formula you're talking about—which I think we're mighty close to—he still wouldn't want to say anything about it because he would want to win with it. It's another tool; you want to protect it. It's one unfortunate thing about racing, but secrets do have a way of leaking out. There's a lot of espionage going on. But as a driver, once you have driven a car that's pretty close, you're never satisfied again until you can get every car you drive to run that way.

With what degree of accuracy can you,

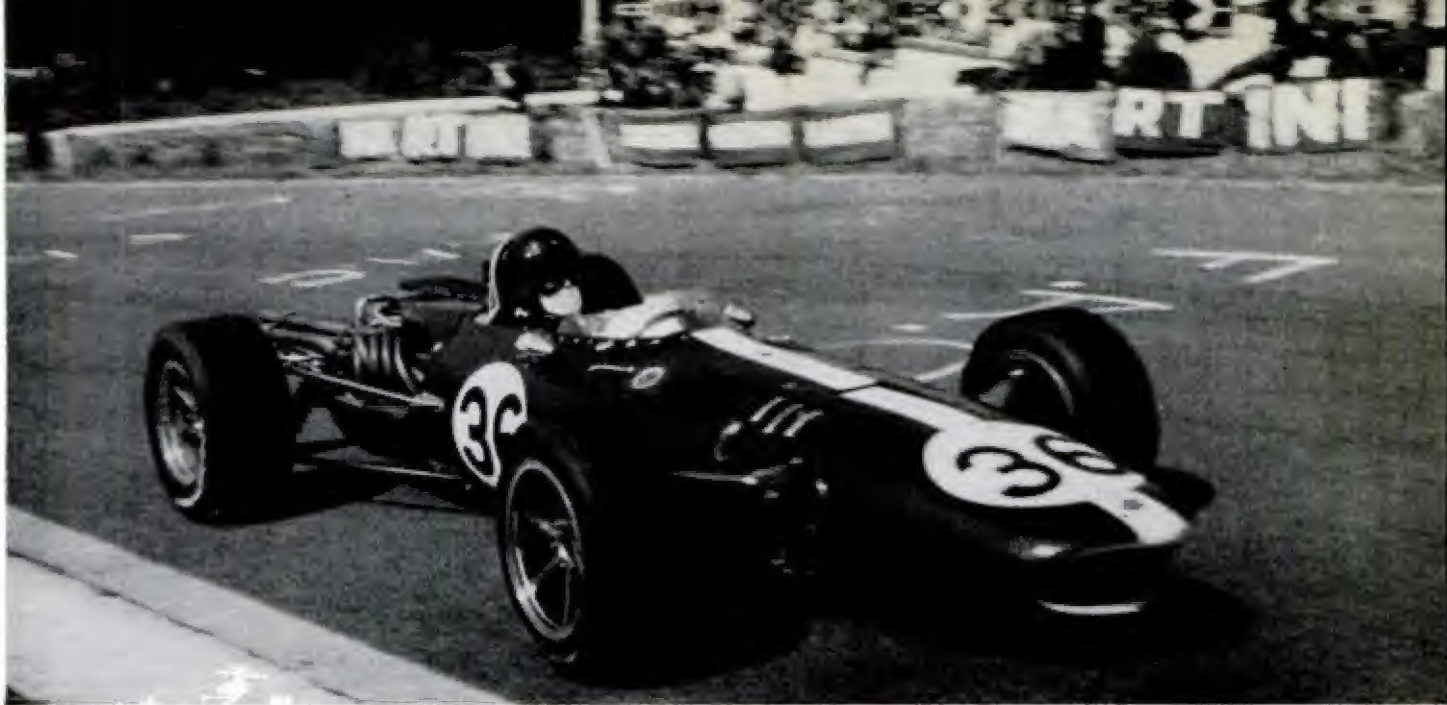


OUT ON THE FIRST LAP in the pileup at Indy in '66! I'd rather run a whole race and go out on the last



I'VE HAD MY SHARE OF CHAMPAGNE, I guess. In fact, at Riverside, it was pretty much an annual event

POPULAR MECHANICS



WINNING THE GRAND PRIX at Spa, Belgium, in my Formula 1 Eagle was definitely my biggest racing thrill

on a road course, sense whether you're down a second on a lap or up a second?

On a track where you have a two-minute lap or a minute-and-a-half lap I think you can tell within a few tenths of a second. It's more difficult to tell when you're several seconds off the pace than when you're running right on your limit. At that point you can tell: "Now there was a good lap." It's very seldom when you go into the pits that you look at your times and are surprised.

Do you think you've just been lucky in the fact that your career has been relatively accident-free?

Well, there's a great deal of luck involved. But I also feel that I was a more conservative driver than many.

How could you be conservative and yet qualify on the pole or in the front row so often?

I'd say that one basic difference was that I drove more on anticipation than on reaction. If you anticipate something is going to happen, you're going to know about it sooner than someone who waits till it actually happens. This applies to the highway as well as the race track.

Won't an owner take a guy out of a car if he doesn't think he's pushing it hard enough?

That's his prerogative. It's part of racing.

Are there some drivers you don't like to drive against?

MARCH 1971

I'd rather race some drivers more than others. As a rule, the predictable ones are best to race against. I'd rather race against the better-known ones and those that have fewer accidents.

Do you think A. J. Foyt will retire?

I really don't know.

In a sense he's doing the same thing you are—building cars.

Yes, he's had a big engine business going with Ford four-cam engines.

Would he have been a great Formula 1 driver if he had really gone in for it?

That's difficult to say. I felt that A.J. didn't take to road racing as quickly as some others—Mario, for instance—but I would never underestimate A.J. If he'd never had any oval experience and had determined to go into road racing, I think he would have become a star.

What was the biggest single disappointment in your racing career?

The first one that comes to mind was when I was leading the Belgium Grand Prix in 1963 and ran out of fuel. Another, the German Grand Prix with three laps to go and a 40-some-second lead and I lost the universal joint. That was in our own car, an Eagle.

What was your biggest win—your biggest thrill?

At the time, it didn't seem that way,

(Please turn to page 210)



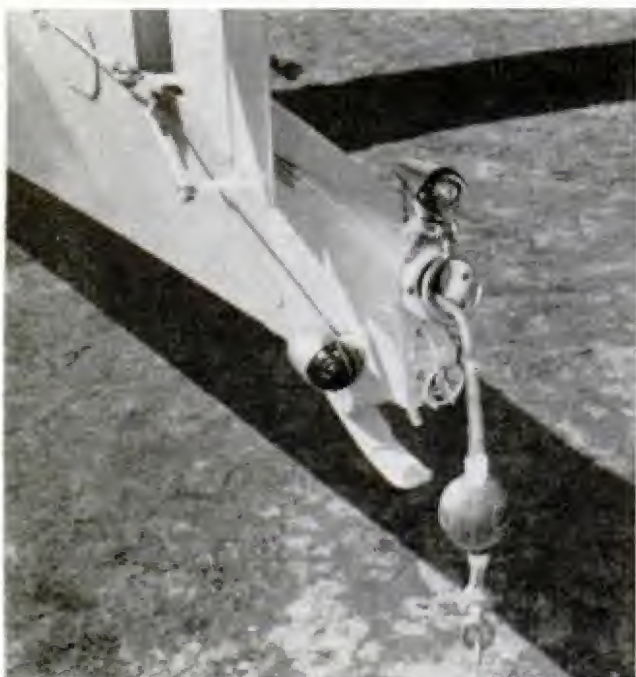
Mickey's mini

Built just like a big one—with tubular steel frame and fiberglass body—Mickey Thompson's new mini-dragster is powered with a 3-hp Tecumseh engine. The 150-pound car sells for \$395.



Stripping keeps it cool

Instead of installing airconditioning in a new department store in Stuttgart, Germany, the architects placed 957 movable aluminum strips outside the windows to reflect the heat of the sun away from the building.



Wood plane for towing

Constructed entirely of wood except for steel fittings, the Poly V is a prototype tug airplane for towing sailplanes. It was designed by a student group at the Technical University of Denmark. An electric winch aft of the pilot pulls in the nylon towline (photo, left) after sailplane release. The plane can perform 7 or 8 launches per hour.



ATV drives like a car

The Wedge 295, a new all-terrain vehicle from the New Holland Group of Sperry Rand, features automotive-type controls, land speeds of 33 mph and water speeds of 6 to 8 mph with an optional jet pump installed.



Electric car for Tokyo

A system of computer-controlled electric cars, developed by the Japanese government and Tokyo University, will be tested this spring. One of the designs (above) is a city car that grips a rail with two front "arms."



Soviet catamaran is stable

Even in Force 10 winds, the double hull of this catamaran remained very stable, reported the Russians after the ship completed a 3½-month scientific voyage in the Arctic Ocean.



Spotter for border crossings

A soldier riding in a bucket seat suspended on a steel frame can spot footprints of terrorists who cross the Israeli border. Elevated, he avoids danger of stepping on a hidden mine.

'Dream car'

This "millionaire's dream car" was built by Sidney Carlton, a director of the Explorer Motor Co., in collaboration with Len Bailey, Ford Motor Co. design engineer. The long, low vehicle is powered by a three-liter Ford Zodiac engine. A bigger engine may be used in the production model if public reaction is favorable and the car actually is offered for sale, according to Mr. Carlton.



The 411 Series: Volkswagen's Luxury Line

It's happened: VW has a 4-door sedan with automatic transmission standard!

By BILL HARTFORD, Auto Editor

THE UPHILL BATTLE for VW 411 models won't be in performance—not with a competitive, 85-hp fuel-injected engine—but in acceptance by many Americans. For some strange reason, many of our home-grown automobile drivers feel the only good VW is one with a sticker dead on \$1899. When they learn the 411s are in the \$3000 price range, the reaction will be automatic: Back to Detroit. Does that much money imply exotic foreign machinery? Does it indicate a preference for a domestic compact or intermediate with a sticker of \$2700 that you can have the



FOUR-CYLINDER ENGINE, under the floor in the three-door (station wagon) model, is fuel injected

92



LOUVERS IN LID of the four-door sedan are for the air-cooled rear engine. "Trunk" is in the front

POPULAR MECHANICS

Material provided by Volkswagen of America

dubious pleasure of running up to \$3545 in the wink of an eye?

Whatever the reason, overlooking 411s because "they cost too much for a VW" would be a mistake. My impressions of driving the four-door from Wolfsburg to Hamburg right after the model was introduced in '68 are still quite vivid. Right off, the front bonnet swallowed a huge flight bag and a collection of small packages and could have held more. The two-lane road I took through the North German farmland was not unlike the roads of Martha's Vineyard where John Linkletter, *PM* Managing Editor, drove the first 411 wagon to arrive here (VW calls it the "three-door"—the third door being the tailgate). The big-car feel and ride was a reaction we both shared. (It does have that rear-engine susceptibility to crosswinds, however.)

The 179.2-inch-long 411 is far from a boat, however. On the sometimes winding, undulating and strangely cambered stretches to Hamburg the four-wheel independently suspended, rear-engine sedan exhibited tenacious road-holding and a preciseness of steering not found on large domestic sedans with standard suspensions. Body roll was slight and steering had plenty of feel. The 411 uses McPherson struts up front. Their use marks VW's first departure from torsion-bar front suspension. Now, the Beetle, too, uses this

suspension arrangement (see *It's a Super Beetle!* page 24, Dec. '70 *PM*).

Since its European introduction, the 411 has benefited by several refinements, the most significant of which is Bosch electronic fuel injection. This boosts hp and puts top mph in the mid 90s—the fastest production VW yet! The 411 can cruise all day at this top speed, but performance in the lower ranges with the standard automatic transmission is more sane than sizzling. Regrettably, no four-speed box is available here. Certainly the imports have lost sales in the past because of the lack of an automatic transmission option; now (to a lesser degree VW would hope) it could be the other way around!

Many features of the 411 may not quickly be noticed by someone not used to human engineering. How about seats that adjust for *your* driving position and not that of an anthropomorphic dummy? How about ventless side glass that is ingeniously notched on the leading edge for draft-free ventilation when the window is slightly cracked open? How about map pockets and three-point belts? Separate heater controls for each side of the car?

There's a lot to like about the 411. Too expensive for a VW? Not by today's prices and especially not for a superbly finished car that—being a VW—will probably depreciate at a Beetle's pace! ★★ ★



411 SEDANS and wagons are not in VW showrooms yet, but should start arriving from Germany soon
MARCH 1971

SPECIFICATIONS—VW 411

ENGINE—Four-cylinder, horizontally opposed, overhead-valve, four-stroke, air-cooled rear engine. Displacement: 1679 cc (102.5 cu. in.). Compression ratio: 8.2:1. Bore: 3.54 in. Stroke 2.60 in. Max. SAE hp: 85 @ 5000 rpm. Max SAE torque: 99.4 ft. lbs. @ 3500 rpm.

ELECTRICAL SYSTEM—12 volts

TRANSMISSION—3-speed automatic

CHASSIS—Front suspension: McPherson struts, coil springs, antiroll bar, double-acting telescopic shock absorbers. Rear: Semitrailing arms, coil springs, antiroll bar, double-acting shocks

TURN CIRCLE—37 ft.

TIRES—Tubeless radial ply

BRAKES—Disc front, drum rear

DIMENSIONS—Length: 179.2 in. Width 64.9 in. Height: 58.5 in. Track: front, 54.2 in.; rear, 53.1 in.

CURB WEIGHT—2425 lbs. (sedan); 2469 lbs. (wagon)

FUEL CONSUMPTION—20 to 24 mpg.

How the Airlines Hope to Stop Bombs And Bomb Scares

Chemosensors that sniff out the telltale odor of explosives, and neutron activators that reveal bombs concealed in luggage are promising new developments

By MORT SCHULTZ

HOW SAFE ARE YOU from a bomb when you fly a commercial airliner?

On the surface, the answer seems to be "reasonably so." In all, 173 people have perished in six bombings of U.S. passenger planes. The first fatal explosion was in 1933; the last, in 1962.

Why, then, did Carl Eck of the Airline Pilots Assn.'s Air Safety Committee tell me that the situation has become "very critical"?

Why has the Federal Aviation Administration suddenly shown great interest in bomb detectors, especially chemosensors and neutron activators?

Chemosensors, which literally "sniff out" odors given off by explosives, were developed two years ago by the Illinois Institute of Technology Research Institute in Chicago. Neutron activators, which seek to find bombs by bombarding an area with neutrons, are being worked on primarily by North American Rockwell, Los Angeles.

In short, why all the fuss when there have been only six fatal American air-

Photo by Bruce Nett



craft bombings in the past 37 years?

For two reasons. First, because the number of bombings worldwide has taken a sharp jump of late and, as one FAA official put it, "We're afraid this thing could snowball."

Secondly, because there have been American planes bombed in recent years, but the facts have been hushed up.

On the world scene, 47 people were killed last February when a Swissair jetliner exploded shortly after taking off from Zurich for Israel.

A day earlier, an Austrian Airlines cargo plane bound for Israel had a gaping hole blown into its fuselage by dynamite. The plane managed to land safely.

In May, an Iberian Airlines jet that was about to take off was quickly evacuated and towed to a remote corner of Madrid Airport after a bomb threat was received. Minutes after the towing vehicle disengaged itself from the aircraft and drove away, a bomb in the plane exploded.

In the United States, recent bombings have resulted in no fatalities. One case occurred in late 1968 when a fire broke out in the passenger compartment of a United Airlines jet that was flying over Denver. It was extinguished and the plane landed. Investigation revealed that the fire was started by a fire bomb.

Another bombing involved an American Airlines jet flying over Alamosa, Colo., in 1967. Dynamite exploded, but no one was killed. Since no damage was done to a critical part, such as a control cable, the pilot was able to make a safe landing.

Bombings, of course, are a great danger. But there is another problem that pilots and airlines fear—bomb threats. They are costly, numerous and increasing.

The exact number is tough to pin down. The FAA puts it at about 400 a year. The FBI says it runs into "the thousands."

A pilot, who at the time was flying an Eastern Airlines shuttle from LaGuardia Airport to Washington National, describes what happens when an airline gets a bomb threat:

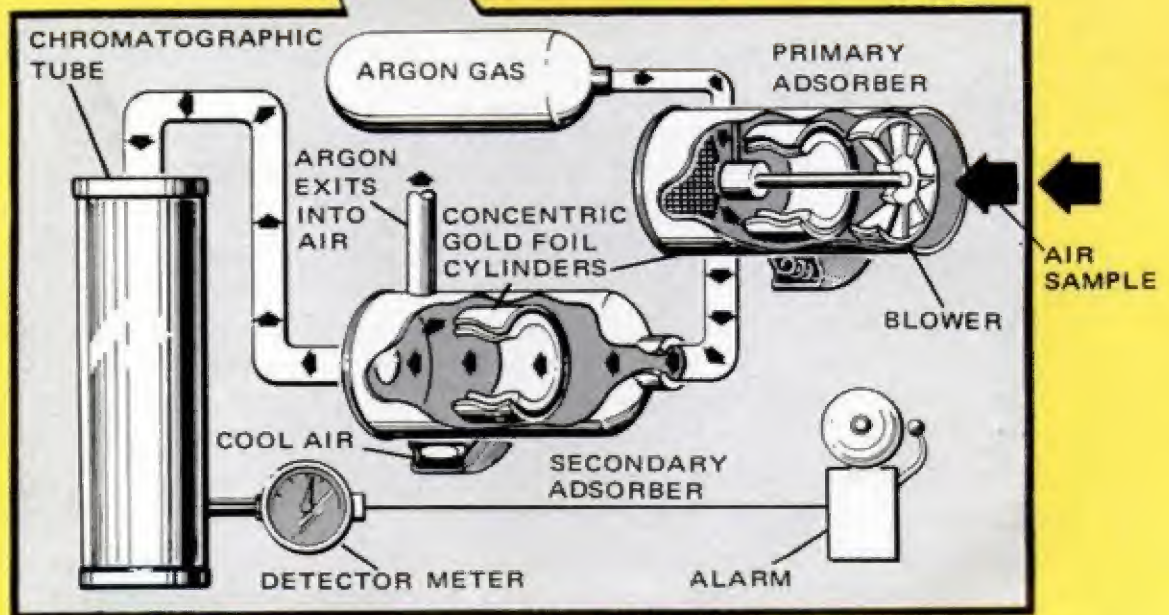
"The message was relayed to us by the tower as we were about to take the runway. We taxied back in, parked the plane, unloaded the passengers who were questioned by the FBI, and manually searched all the luggage. No bomb was found.

"I wasn't too worried, because we were on the ground. I would have sweated a lot more had we been in the air."

Which was exactly where American Airlines flight 160 was when it got its call last May. It had taken off from Toronto for New York City when the pilot was informed by radio that a bomb threat had been received.

Air traffic in the Buffalo area was cleared away so the plane could make





ARTIST'S CONCEPT OF AIRCRAFT INSTALLATION: Air sample is drawn into primary adsorber. Argon transfers adsorbed vapors to secondary adsorber. During the transfer, the cooling element speeds adsorption. After adsorption, vapor is heated for transfer to a gas chromatographic partition tube where it is absorbed to get a time pulse. This is recorded by meter. If any EDGN is present, an alarm sounds

an immediate landing. The 100 passengers were unloaded, and the 727 was allowed to sit for 30 minutes before it was boarded for a search. No bomb.

Can airlines guarantee that a plane on which you are seated isn't carrying a bomb? Chemosensors and neutron activation may make it possible.

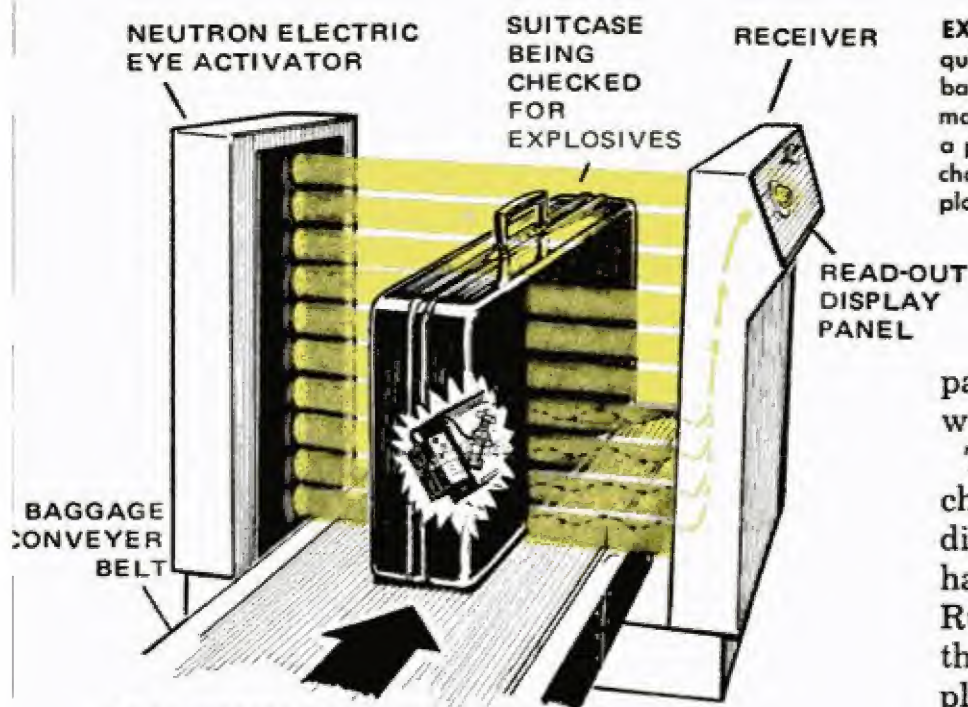
A chemosensor recognizes a characteristic vapor emitted by an explosive. It can detect dynamite by recognizing ethylene glycol dinitrate (EGDN), a by-product of nitroglycerin. Dynamite contains nitro and emits EGDN.

Chemosensors would be used to sample the air in a plane's passenger compartment before takeoff. If a vapor emitted by an explosive were present, an alarm would sound in the cockpit.

"But chemosensors aren't sensitive enough to detect vapors given off by an explosive which is placed inside a tightly sealed suitcase," explains Max Collins of the FAA. "That's where neutron activation comes in." Collins is chief FAA troubleshooter in this field of detection equipment.

A neutron activation gun would bombard luggage with neutrons before it was loaded on an aircraft. If neutrons strike inert material—as they would if explosives were present—gamma rays are given off. The density of these rays reveals when the inert material is equivalent in mass to a bomb.

In activation analysis, a neutron source having a specific energy output must be used to amplify the presence



NEUTRON EXPLOSIVE DETECTOR

Art Concept by Fred Wolff

EXAMINATION OF LUGGAGE can be quick, conclusive. Activator bombards bag with neutrons. Contents emit gamma rays; their energy is measured by a photo-multiplier tube. Density of rays characteristic of dynamite or other explosive gives instant read-out on panel

passengers, but probably won't be.

The principle upon which chemosensing is based was discovered in 1906 by Mikhail Semenovitch Tsvett, a Russian botanist. He found that the different parts of plant pigmentation could be distinguished by the way in which they clung to and flowed down an adsorber—

of the element being sought while suppressing the activity of other elements.

Looking for a mineral, such as silicon, a geologist will shoot a specific number of neutrons in the Mev range into sand and rock. This might be a beam of 14-Mev neutrons. (A Mev is equal to one million electron volts.)

The irradiated (activated) atoms become radioactive and emit high-energy electromagnetic radiations called gamma rays. Gamma rays can be analyzed for their energy on an instrument having a photo-multiplier tube. This output can then be read on an oscilloscope.

Since the energy output of the gamma rays given off by one element differs from that given off by other elements, you can locate that element in a table of data.

The geologist will know that silicon is present if the gamma rays he gets have an energy output of 1.78 Mev, which is that of aluminum 28, one of the trace elements of silicon.

Neutron activators would be used to examine luggage carried on by passengers as well as that being loaded into the cargo compartment. Neutron activators could also be used to scan

in this case, limestone. Adsorption is the adhesion of molecules to a surface.

This process of separating parts of pigmentation by their flow characteristics is called chromatography. A vapor, too, can be separated into its distinctive parts (or gases) by running it over an adsorber. Molecules of various gases have different rates of flow.

A vapor acts much like a liquid consisting, say, of oil and water. If you poured this down the side of sheet metal, the two would separate and each would reach the bottom at a different time.

The first chemosensor developed by the Illinois Institute of Technology Research Institute (IITRI) for the FAA was for the detection of dynamite, since this explosive is the easiest for a bomber to obtain. Jay Fischman of IITRI, who was chief engineer on the project, told me how this chemosensor works.

With the aid of a small fan, air from an airliner cabin is scooped into a cylinder containing three concentric gold foil cylinders that adsorb EGDN. Gold is used because it is an excellent surface for adsorption of EGDN.

(Since the dynamite chemosensor was

(Please turn to page 188)

WEIRD, WILD and WONDERFUL

Bright Ideas From The Biggest Inventors Show Yet

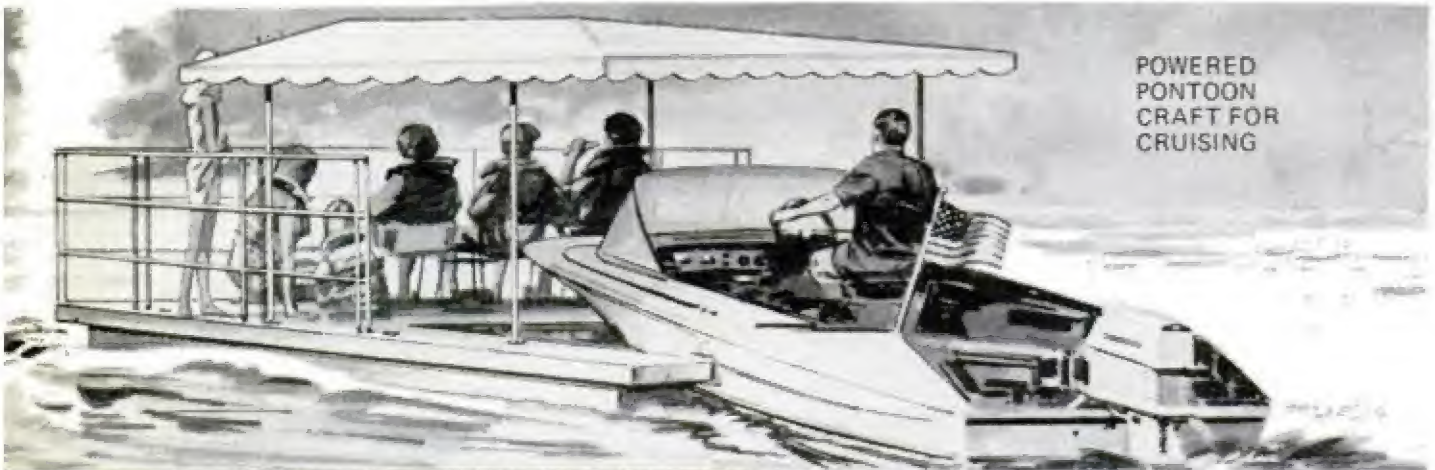
On these six pages, PM brings you exciting highlights from the huge International Patents Exposition held last month in New York. Sponsored by Patents International Affiliates, Ltd., the annual event—largest of its kind—draws thousands of new inventions from all over the world. Here are some of the brainiest and zaniest. Most are not yet on the market. For more information, write Patents International at 680 Fifth Ave., New York, N.Y. 10019.

By **SHELDON M. GALLAGER**

Illustrations by Roy Grinnell

IT'S A BOAT! IT'S A DOCK! Well, actually it's both. The clever pontoon float cruises along pushed by an outboard with its bow fitted into a recess in the deck. Anchored, it becomes a swimming raft, and the outboard

can be detached for use as a runabout. Tied up back at shore, it's a floating dock. In bad weather, the outboard can be stored on top with the canopy lowered for protection. Inventor is Vernon C. Runkel of Kansas City, Mo.



POWERED
PONTOON
CRAFT FOR
CRUISING



SWIMMING RAFT
WITH OUTBOARD DETACHED



BOAT STORAGE SHELTER
WITH CANOPY LOWERED



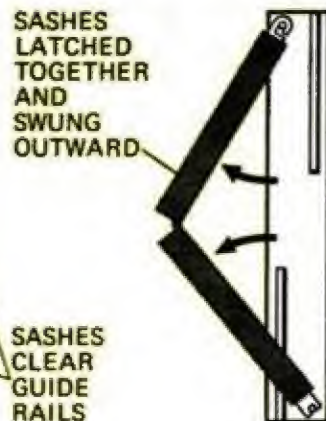
YOU CAN'T HAVE A FLAT with this ingenious sectional tire invented by Samuel C. Pellegrino of Buffalo, N. Y. Each of the 12 segments is self-contained and inflated through its own valve. If one is ruptured, the tire will continue to function normally, eliminating the danger of high-speed blowouts. Instead of a spare wheel, you just carry along a few extra segments for replacement as needed. In winter, the sections can be rotated slightly, as shown at right. This offsets their edges for added traction and eliminates the need for snow tires, Lugs, easily reached behind the hub cap, hold segments on.



INWARD-FOLDING WINDOW is cleaned from inside the house, eliminating the difficulty and danger of having to lean outside to reach it. The two sashes are first slid up and down so they're reversed from their normal positions, with the lower sash at the top and the upper one at the bottom. This slips them off their guide rails so they're free to pivot sideways on hangers at the top and bottom. They're then swung into the room and hooked together at the ends with small catches. Finally, the upper sash is pulled down along its balance tubes, lowering the whole assembly within easy reach. Outer sash is slightly narrower to clear inner tracks. The handy window was invented by Henry J. Hendra of Montreal.



UPPER SASH CLOSED



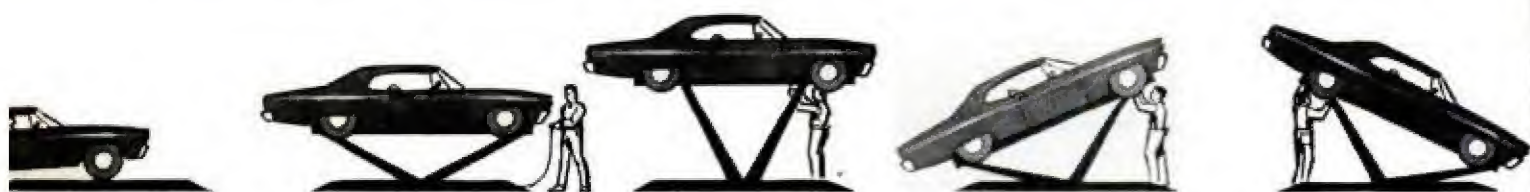


TILTED DOWN FOR QUICK REMOVAL



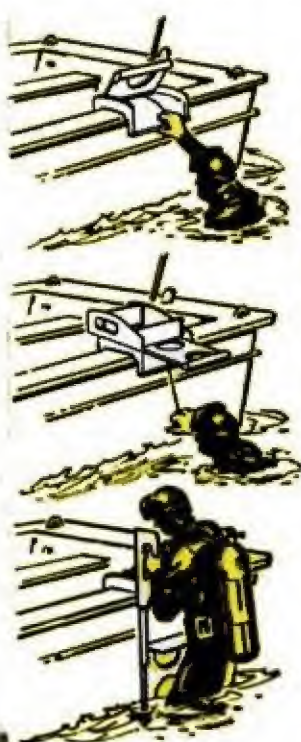
STOWED FOR TRAVELING

PIGGYBACK BOAT CARRIER for campers is double-hinged so it can swing up and down or sideways. Pivoted sideways, it gives access to the camper's rear door without your having to remove the boat completely. To unload the boat, you lock the horizontal pivot and release the vertical one, allowing the carrier to swing down to the ground. The vertical pivot bar also holds an outboard engine on a separate bracket. Inventor is Gilbert J. Johnson of Seattle, Wash.

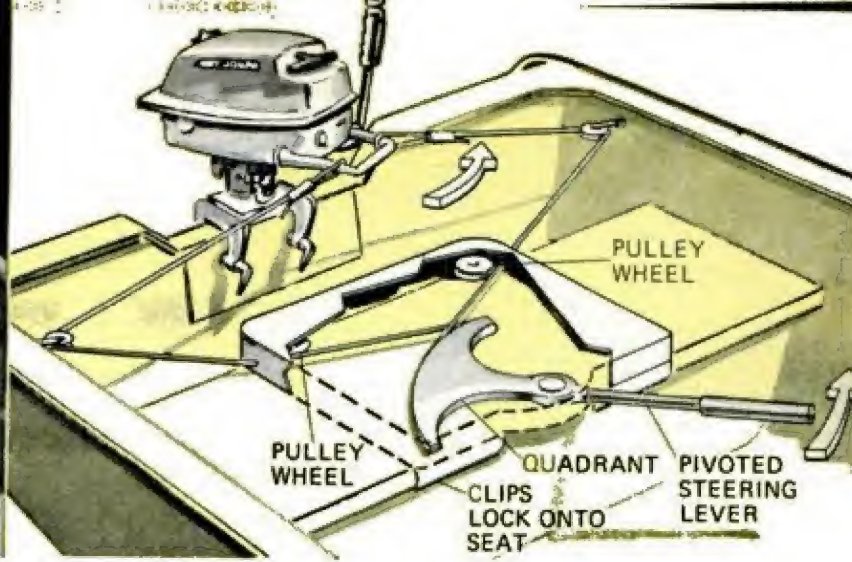


TILTING AUTO LIFT enables a mechanic to reach either end of a car easily. Hydraulically operated, the lift is raised by V-shaped arms until the car is well off the ground. Then it pivots at the center to tilt the

car in either direction, tipping up the front or rear as needed. The slanted position provides a more comfortable working angle and eliminates the strain of reaching overhead. Octavio Alvarez Suarez of Gijon, Spain, is the inventor.



FLIP LADDER stows inside a boat, but can be lowered on the outside by a swimmer in the water. Pulling a cord swings the ladder up and over the gunwale. Telescoping leg sections then slide down the outside of the hull into the water, enabling a swimmer to board the boat easily. Invented by A. O. Akermanis of Orlando, Fla., the ladder stows out of the way inside when not in use.



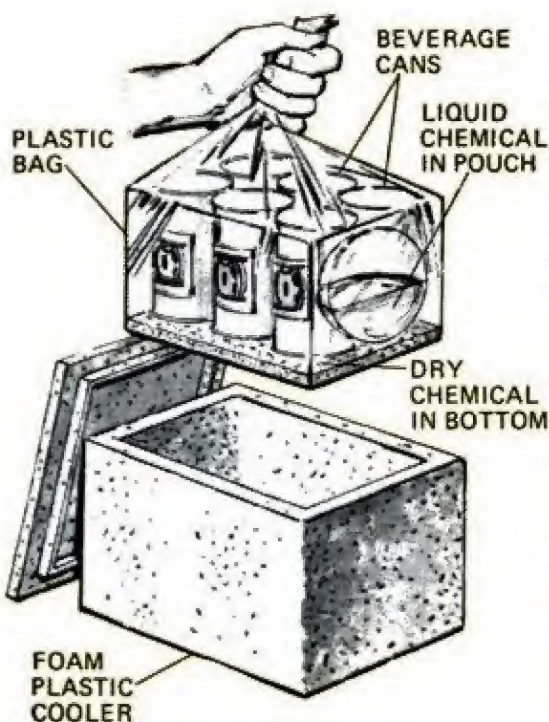
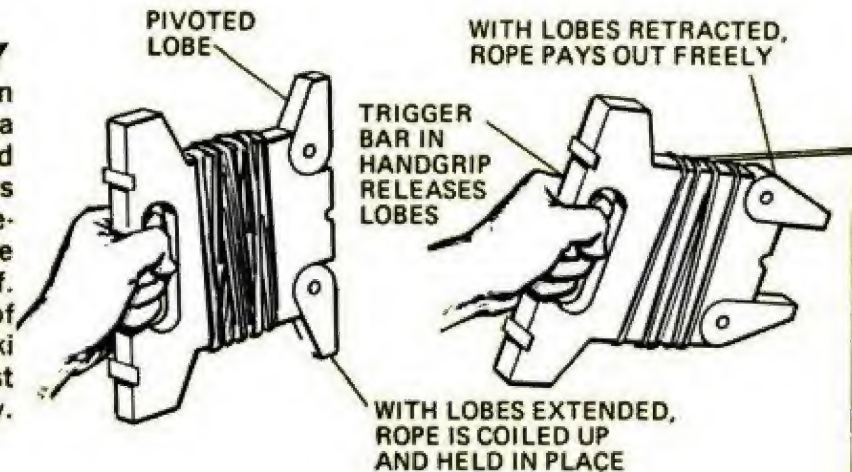
YOU STEER WITH YOUR KNEES

with this no-hands control for fishermen. An auxiliary tiller bar clamps to the seat and turns the engine through a system of pulleys and cables. A swiveling seat is mounted on top of the tiller mechanism so that a slight

twist of your body steers the boat in the direction you want to go, freeing your hands to hold the pole. The tiller can be rigged to move with or opposite to the engine's rotation depending on the action preferred. The inventor is A. O. Akermanis of Orlando, Fla.

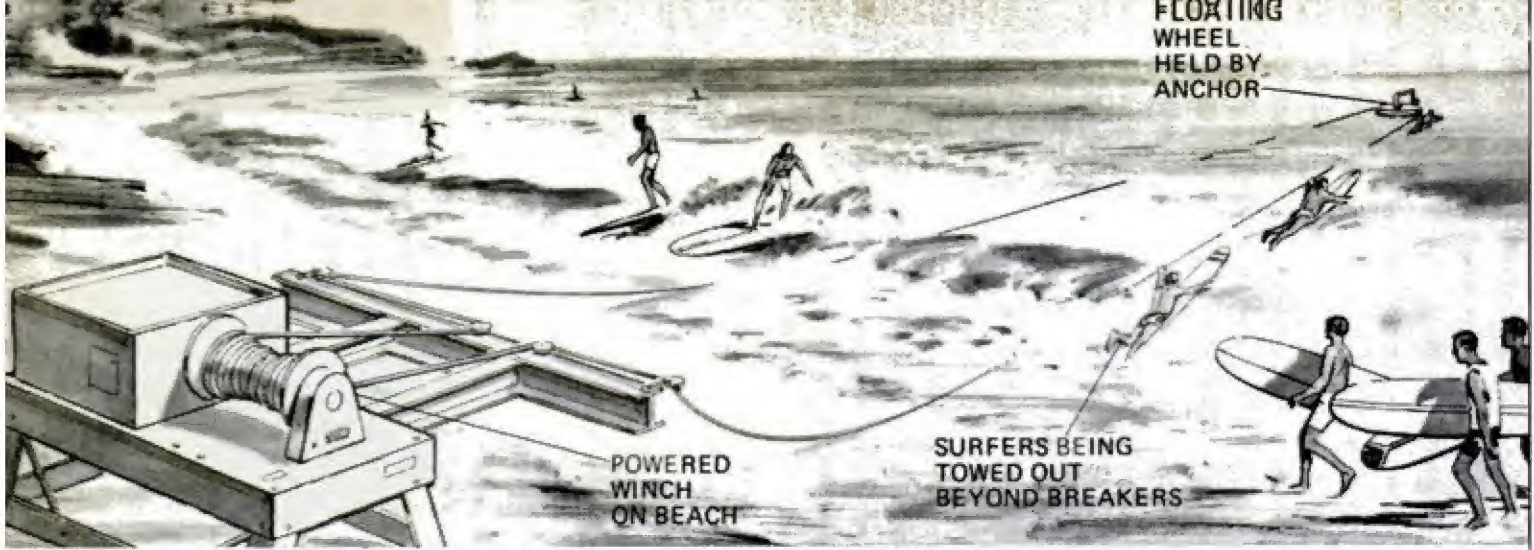
TWO-WAY ROPE CADDY

stores a line so it can't slip off, then lets you pay it out at the push of a button. Pivoted lobes at the outer end spring up to hold the coil in place as you wind the rope on. Squeezing a release in the handle then retracts the lobes so the rope slides easily off. Made by New Horizon Enterprises of Largo, Fla., the device is for water-ski tow ropes and anchor lines that must be reeled in and payed out frequently.



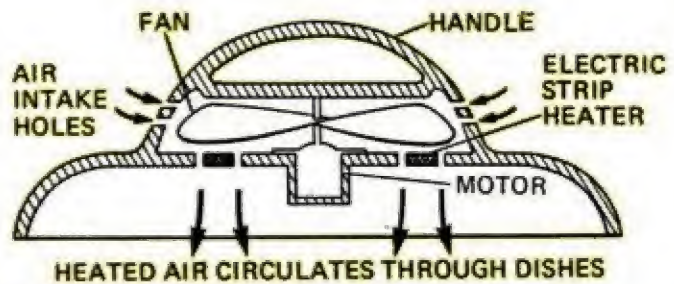
INSTANT COOLER chemically chills a six-pack of beer or soft drinks in minutes for picnics and impromptu parties. The cans are sealed in a plastic bag containing a dry chemical in the bottom and a liquid chemical in a pouch in the side. Squeezing the pouch breaks it, mixing the chemicals to start an endothermic reaction that quickly cools the cans. In an insulated container, they stay cold for hours. Inventor is Marvin Holt of Saugus, Calif.





WATER TOW FOR SURFERS is a new switch on the ski-tow idea. You hang onto a rope as it pulls you out into the surf, then let go and ride the waves in. The rope runs out and around a large floating pulley anchored

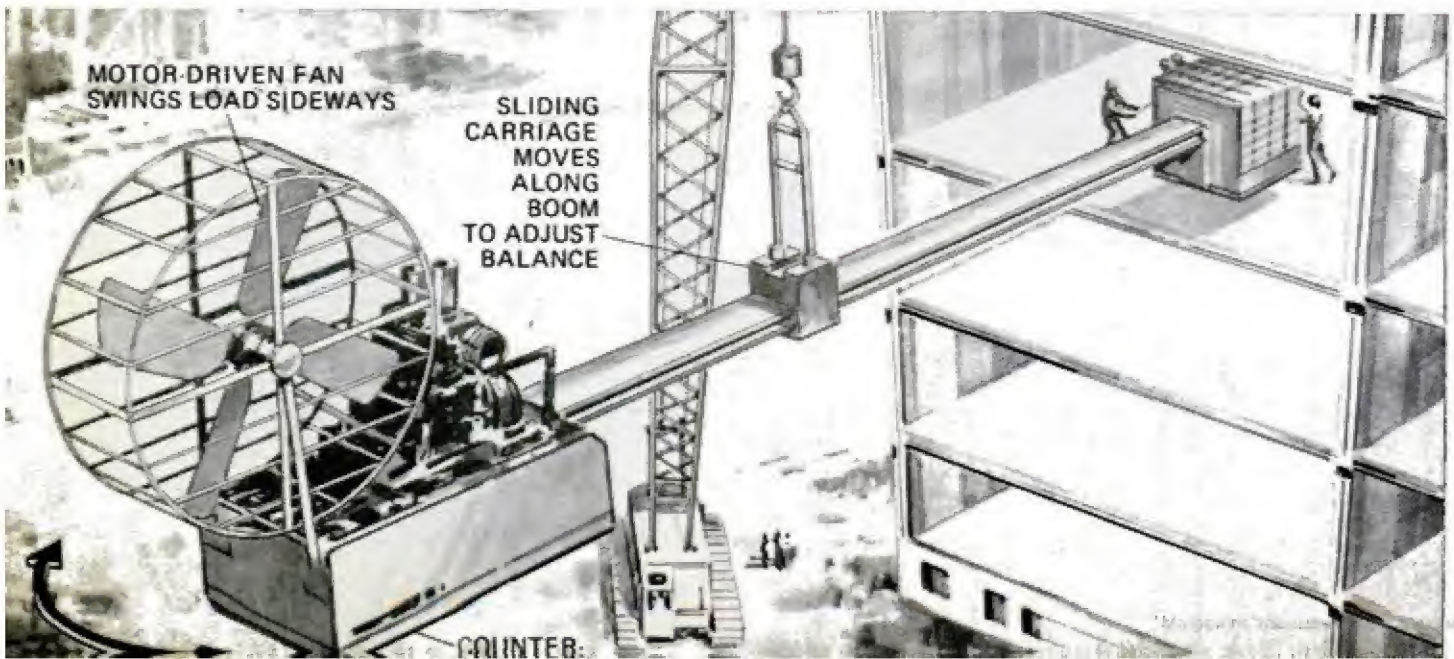
offshore. Invented by Edwin V. Hanson of Seattle, Wash., the tow not only gives outbound surfers a lift, but also eliminates the danger of their being struck accidentally by inbound surfers since the two are kept apart.



QUICK DRYING OF DISHES is the object of this invention by Sibyl Krausz of Pacific Palisades, Calif. It slips over a standard dish rack and forces heated air downward to speed the drying action and save hand wiping. It can also be used to prewarm dinner plates or keep food hot. When it's not in use, its flexible sides fold inward underneath for easy storage.

PROP-POWERED CARGO BOOM steers itself in and out of tight places using a rotor on the rear end. The remote-controlled rotor can be reversed to swing the boom sideways in either direction for precise position-

ing of construction materials and other loads. Suspended from a crane, the boom slides forward and back, automatically adjusting balance point to keep load level. Logan Greeson of West Palm Beach, Fla. is the inventor.



CONVERTIBLE CRAFT

switches quickly from surfboard to sailboard to motorized skimmer depending on your needs at the moment. A well in the center lets you slip in a small outboard engine mounted in a special housing. This gives you a powered surfboard for use where there are no waves to ride. With the engine removed, the well opening is covered with a deck insert, and the craft becomes a conventional surfboard or paddle raft. If a breeze comes up, you just slip a mast into a socket and attach a small canoe-type sail. Bolt-on lee boards give the effect of a keel and stabilize the board for tacking into the wind. Maker is Berkshire Crafts of Media, Pa.

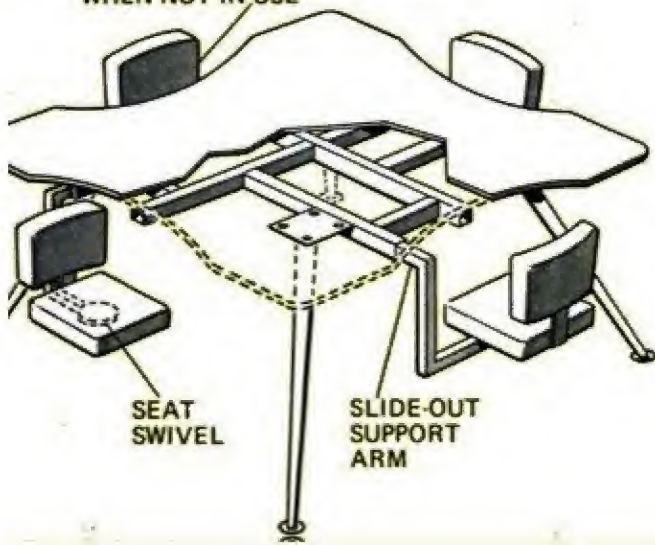


YOU DON'T TRIP OVER any chair legs getting in and out of your seat at this novel dining table invented by Gordon E. Rogers of Boise, Idaho. The seats are suspended from the table on slide-out bars and swivel for easy accessibility. When not in use, they retract out of the way into recesses in the tabletop. Object of the design is to save space and permit easier cleaning underneath.

LADDER WITH A HOLLOW LEG makes it easy for fruit pickers to drop fruit harmlessly to the ground without having to climb up and down themselves. The fruit slides down the tubular leg and pops out at the bottom into crates. It feeds into the leg from a hopper that can be moved from rung to rung depending on how high the picker works. Inventor is A. O. Akermanis of Orlando, Fla.



SEATS RETRACT UNDER TABLE WHEN NOT IN USE





New Breed of Offshore Fishermen

Anyone cruising the coast in such small, open hulls a generation ago would have been called foolhardy. Today, he's the envy of all men who go down to the sea to fish. Here's why . . .

By GEORGE W. REIGER



SOME CLAIM the first hull was an accident; manufacturers insist it resulted from careful planning. But everyone agrees that the new stable center-console designs are tailor-made for anglers who like to fish beyond sight of land but can't afford a cruiser.

One story has it the Bahamian Crown Colony Club asked for a boat that could negotiate the shallows for bonefishing, yet handle the Gulf Stream and battles with big marlin. This search for a hull with a two-in-one capability turned out the Aquasport, and the success of this

SOME CENTER CONSOLES stress big water, some the shallows. Sea Lark, above, is a 19-footer with a 115-hp Volvo/Penta in-board and a tunnel stern enabling it to run in water just 6 inches deep. Fisher-Pierce, builder of the Boston Whaler, has come up with the Outrage (at right) for anglers who like to work a turbulent shoreline from a reliable, seaworthy hull. Price of the Sea Lark, \$5595; the Outrage: \$3950





LARGEST of the fleet is Trojan's 25-footer (top left) next to one of Mako's three models (17, 19 and 22 feet). Middle left is an Aquasport, the boat that started the trend, with a Stamas Tarpon charging in from the right. Below is MFG's new Fishing Caprice, modeled from the hull of the 18-foot deep-Vee Caprice. Two captain's chairs behind the console revolve 180° to become fighting chairs in the event of a big one. All these boats are fully trailerable—another plus for the new offshore fishermen



MARINE ALUMINUM is used in a number of "off-shore" models. Above, Chrysler's Fin Runner weighs but 875 pounds, yet can carry 3000 pounds. \$1730



LIVE-BAIT WELL is a bonus feature in many offshore fishermen. This 19-foot center-console model from Cobia has a large one aft; boat sells for \$1700



THIS 19-FOOTER from Glastron boasts high fuel capacity with an integral 18-gal. tank and space for three 6-gal. standard outboard tanks under the seats



WATER JET UNITS offer unparalleled shallow-water capability, none more so than Buehler's 18-foot Nimrod II with "jet-age" console and roomy cockpit



company sparked other Florida firms to produce their own versions. Today most makers have an "offshore fisherman" model.

What distinguishes this design? It's a boat with enough freeboard and vee to take open water, yet with sufficiently shallow draft to work close inshore. It has a center-console instrument panel for radio/telephone and fathometer, and the console provides maximum cockpit space and casting room. Sometimes there's a built-in live-bait well and usually a large-capacity fuel system for long cruises. The boat has enough power to get there in a hurry, yet is equipped (by running on only one of two outboards or, perhaps by using a small auxiliary) to troll long hours. For a maximum expenditure of \$5000 for boat and motors (more often closer to \$3000), an angler has all he needs to pursue walleye in Minnesota or wahoo in Florida. ★★★

SELF-BAILING COCKPITS and bow-casting platforms appear on many offshore models and are found on this Pro Line 24. Options include marine head and twin 21-gal. fuel tanks



ANOTHER ALUMINUM MODEL, this 18-foot deep-Vee hull from Mirro-Craft has positive flotation. Bow safety rail and running lights are standard equipment. Price is \$1350

SOME CENTER-CONSOLE THINKING has gone into Lund's 14-foot Fish 'n Ski outboard with a 40-hp capacity and ample room for fishing or skiing. Suggested retail: \$695



MINI-MODELS include Shell Lake's 14-foot Nipigon (left). Part "bass boat," part "center-console fisherman," this Shell Lake creation can handle up to a 60-hp motor





New 1971



IMPROVED VERSION of Mossberg's successful Mallard Tri-Spar (no boom) design is still only \$399



FOR YOUNG AT HEART, Alcort's new 12-foot Mini-Fish with a 65-sq.-ft. lateen-rig; it costs only \$400

HOUSEBOATS are increasingly the trend in summer homes on the water. For \$16,650 you can have this 37-foot mobile, all-season lodging from Boatel, perfectly designed for family vacations and weekend trips



Boats

Houseboats and sailers lead the way in the colorful season ahead



PUMPKIN-COLORED POWER PACKAGE is MFG's Super Gypsy made especially for water skiers at \$1369



TWIN OR SINGLE Tunnel Drive comes with Penn Yan's 26-foot flying-bridge Vindicator, starting at \$14,500



BOW CONTROLS make "bass boat" a great run-about and fine for fishing; this Monark model, \$700



WANT A COLLAPSIBLE tent trailer that runs on water? Sleep ashore in Sea Space Deck-Line; launch it the next day for a cruise. Complete for \$4490



TRADITIONAL DORY DESIGNS never had it so good! This Sea-safe 18-footer made out of plastic needs only a 20-hp outboard to speed up to 25 mph, thereby providing a modern means of transportation in a time-tested hull. Price is \$1195

RACY LINES in Chrysler's all-new 16-foot Conqueror come from its fast-planing shallow-vee hull, wrap-around back-to-back seating, a deeply padded dash with smartly styled instrument cluster and a sweeping, optional windshield. Priced at \$2105

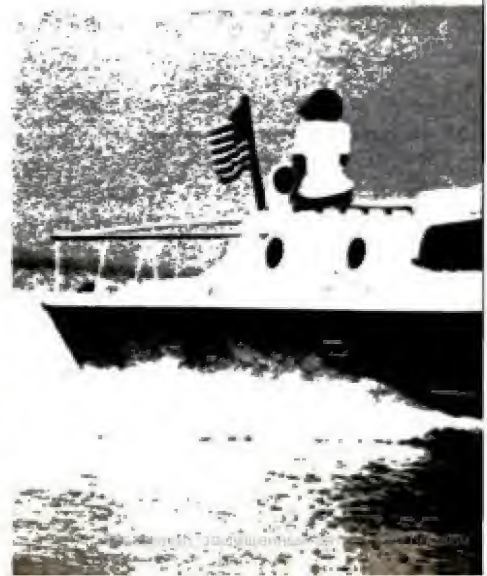


HAZARD OF FIRE AFLOAT in a fiberglass boat has been reduced with new fire-retardant resin (Hetron) used in Uniflite houseboats and said to be 20 times less flammable than ordinary fiberglass. Price, \$25,000



COMBINE A CRUISER with a home in Larson's new 21-foot Cruiser Home. Some standard features include a vinyl hardtop with fully enclosed cabin and power options from 155 to 215 hp. Priced at \$8500

JET-POWERED HOUSEBOAT (below) from Chris-Craft provides great shallow water maneuverability with wonderful open-water speed from two 230-hp engines. Rum Runner (right), Kenner's latest family cruiser, sleeps six, races at better than 34 mph with dual 155-hp engines. Price: \$14,500





COMPLETE WITH RACING STRIPE is this 16-ft. Mustang from Correct Craft. These popular boats are often used by professional water skiers at Cypress Gardens. Powered by 22 horses; price, \$4738



JUST NINE FEET LONG, the Triumph trimaran from Snark Products has five-foot beam that, with the mast down, converts the little sailer into a swimming, skindiving or sunbathing platform. Price, \$349



NEW LAST YEAR and still going strong is Mark Twain's Snoopy, a bow-riding trihull providing enormous cockpit space for skiing, fishing, cruising—any activity afloat. Priced at \$4520 with 120 hp



LIGHTWEIGHT CATAMARANS, once California's "in sailers" are increasing in popularity across country. Above is the 15-foot Sea Spray from Gen-Mar, Inc. Below, Starcraft's Skylark II offers a one-design Marconi cat-rigged tunnel planing hull and gunwale-walking stability; all in a 14-footer for \$795







Wake Surfing Is For Anywhere

PM tests the adaptability of Bertram's Pop-Top Camper — and three frustrated surfers.

By GEORGE REIGER, Boating Editor

TAKE THREE BEACH BOYS, season them with saltwater and sunshine, add three surfboards, and what do you have? Ecstasy! And frustration, too, if surfing conditions aren't up to their breezy standards. After all, these three guys—Ron Caragias, Hank Leonard and Al Newbury—have won some 40-odd surfing trophies attesting to near-professional skill with those slippery slivers of fiberglass.

I'm nuts about the Delmarva (Delaware, Maryland, Virginia) peninsula, particularly the unsettled coastline south of Ocean City, Md. When Hank asked me whether any surfers had ever before explored the area, I replied, "Doubtful," and Hank was hooked.

Ron and Al have no trouble finding time off from work. Most beaches along the Long Island and Jersey shores are so well populated by surfers that the mere mention of sandy stretches and cresting combers unknown to others is enough to "inspire" a four-day weekend!

We trailer a Bertram "Pop-Top" camper behind an Inter-

◀ **SHOWING 'EM HOW**, Hank Leonard (1) rides Bertram wake up Chincoteague channel. 2) First morning finds us stranded with tide out, but by the time we had breakfast, we're afloat again. 3) Ron makes the most of modest seaside wave. 4) Even though wind isn't up, Bertram's 40+ knots makes own breeze. 5) Hank (right) pulls up onto wake's crest before releasing towrope while Ron is still seeking his balance

national Travelall from Neptune, N.J., to Chincoteague, Va. Launch and run to the inlet. The big moment: But where's the surf? For three days we wander in and out of inlets from Chincoteague to Wachapreague and back again looking for the "perfect wave." Halcyon weather prevails—great for fishing, sunbathing or boating, but just no surf for my companions. The second morning out, Hank gets an idea: "With this deep-V hull, we should be able to carve a sizeable

wake at moderate speeds. Let's try wake surfing!" It works. The boys have a perfect wave—mile after mile of one continuous crest. It's great fun for a weekend!

The Bertram performs like a dream. Equipped with two 165-hp Mercruiser stern-drives and a 100-gallon fuel tank, it's ideally suited for coastal cruising and camping. It's priced at \$11,190. For further information write the Whitaker Corp., 3663 N.W. 21st St., Miami, Fla. 33142. ★ ★ ★



FIRST STEPS in "popping" camper top for the night are to unhook hatch and ease it over onto foredeck



THOUGH FOREDECK LOOKS HEAVY, 5-ft.-long section is easily lifted if firmly gripped in the middle



WHILE STEVE HOLDS foredeck up, Ron slides roof rods along support bars preparatory to tightening



FOREDECK UP, boys begin to snap down vinyl side curtains that'd been rolled up beneath the "roof"



"CORRIDOR CANOPY" snaps around mast light to provide weatherproof passage from cabin to cockpit



FINISHING TOUCHES are provided by the author in tying closed the little openings in mastlight seam



GLASTRON/CARLSON'S NEW CV-21 powered with 350-cu.-in., 265-hp jet engine moves at more than 50 mph

New Jet-Powered Boats

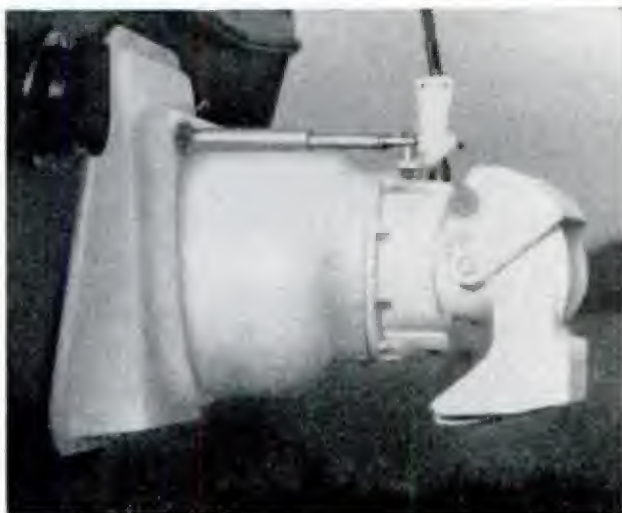
JET POWER is not new. Experiments with water jet systems go back two decades, and jets have been used in family boats for years. They're safe (no props to cut swimmers), maneuverable and have wonderful shallow-water capability since they don't need the draft of prop-driven boats to do their thing. So what's new besides this?

The answer is speed. In any jet system, air or water, great speeds are a result of sleek aerodynamic or hydrodynamic designs coupled with enormous power. The more air or water *impelled* through the system, the faster

the craft will be. But boats must overcome water resistance. And as sheer energy drives nuclear subs along at underwater speeds of 50 knots plus, big engines and jet units are doing the same thing on the surface for a new breed of family power boat. Whereas 40 mph is a kind of sonic barrier for most hull and power combinations, California firms like Checkmate, Sanger and Sidewinder, and now Chris-Craft and Glastron, offer combinations that can keep up with a nuclear sub. Checkmate's Jetmate, for instance, claims 70 mph—and that's moving! ★ ★ ★

BERKELEY JET (below) has moved in to lead competition for civilian users while Jacuzzi is kept busy supplying jet units for the U.S. Navy's patrol boats

CHECKMATE AND CHEETAH feature this 455-cu.-in., 390-hp Olds engine as standard equipment; Ford and Chevy high-performance engines are optional





How to Repair A Fiberglass Boat

By MORTON J. SCHULTZ

NO MATTER WHAT ITS SIZE, if your boat is made of fiberglass you can save yourself a bundle of money by repairing it yourself.

Not long ago, for example, a yard wanted to charge a friend \$75 to patch a couple of gouges in his 42-foot ketch. When we got through doing the job ourselves, it cost \$5 for materials and it looked great.

As long as you know how to match the repair procedure to the damage, repairing a fiberglass hull is easy. But a lot of people fall flat on their transoms for too many believe one repair will suffice for all types of damage.

There's another misbelief we should clear up now. Through-



the-hull fractures seldom occur with fiberglass boats. Fiberglass is a high-strength material with superior resistance to impact. Only a direct collision will cause a punctured hull.

Even if a hull is fractured, you stand a good chance of being able to fix it yourself if the puncture isn't spread over a wide area. A good book on fiberglass boats in general that deals with repairing infrequent through-the-hull fractures is *Fiberglass Boats* by Boughton Cobb Jr. He's manager of the Fiberglass Industrial Materials Div., Owens-Corning. The book can be ordered for \$3 from Yachting Publishing Co., 50 W. 44th St., New York, N.Y. 10036.

Our concern here is how to fix damages that occur frequently. This surface distress can be divided into five classes: gouges, scratches, crazed cracks, wrinkles and loss of gloss.

Most fiberglass boats are made of two

layers of material bonded together by chemical action. The outside layer is a colored gel coat, a special resin material containing concentrated color that provides a smooth, finished surface. The layer beneath the gel coat is a polyester resin which adheres to and is reinforced by laminations of fiberglass mat, cloth or woven roving.

Gel coat and polyester resin are cured by a catalyst that allows them to form a hard, strong mass. The only one of the five categories of surface damage which destroys this mass is a gouge, and that's a good place to start.

● *Repairing gouges.* Once the gel coat-polyester resin formulation is gouged, the damaged material has to be cleaned out to reveal the fiberglass. Rout it out with a putty knife or similar tool.

Clean and rough up the fiberglass with a piece of 100-grit sandpaper to



REPAIR PUTTY must have a firm seat on which to hold, so scrape away all loose distressed material



GOUGE is then sanded with 100-grit sandpaper to remove dirt and provide roughened surface for putty

MIX CATALYST and plastic repair putty on a clean piece of scrap just prior to application of putty



OVERFILL THE GOUGE about $\frac{1}{4}$ inch. Press the putty firmly into place to squeeze out all of the air



assure that the repair putty will have a good base. Then swab the whole area with a cloth that has been saturated in acetone or lacquer thinner to clean away dirt and grime. The area to be repaired must be clean!

Buy fiberglass plastic repair putty at a boat store—polyester is the most suitable. Mix this thoroughly with the catalyst as instructed on the can and apply very firmly. Press the putty in hard to force out air, and build it up about $\frac{1}{4}$ -inch above the surface.

Now, cover the repair with a piece of cellophane. Press it into place with a single-edge razor blade or rubber squeegee. Cellophane protects the patch from air while it's curing. Hold the squeegee at a low angle so it's almost flat. Don't worry about the excess putty that oozes out around the cellophane.

Mask off the damaged area in preparation for finishing. When the putty becomes hard to the touch, remove the cellophane and sand with 220-grit sandpaper to remove excess putty and to surface the patch. Use a vibrator sander if available. If not, use a sanding block.

Wash away sanding dust with water, then hand-sand the area with *wet* 400-grit sandpaper to remove scratches left by the coarser paper, and repeat using 600-grit paper.

Wash the area again, and buff to remove remaining scratches and to restore gloss. If you have a power buffer, hold it at a 45° angle and use a lightly abrasive rubbing compound, such as Mirro Glaze No. 1. If you buff by hand, use a slightly harsher grit compound, such as DuPont No. 7 or No. 101S.

To complete the repair, apply the gel coat finish; ideally, the same used by the boat manufacturer so the color matches. Request the company to tell you where to get it. This material can be brush-applied if you have no spray equipment, but a spray finish is neatest and should be used if possible.

- *Removing scratches.* A scratch caused by sideswiping the slip is a most



MASKING can be done before or after sanding the repair patch. It's necessary to avoid affecting adjacent areas, especially if gel coat is applied by spray



IF YOU HAVE a vibrating sander, use it. Start with 220-grit paper, wash sanded area frequently with water as you work to keep repair zone free of dust



SPRAY FOR BEST OVERALL RESULTS. All you need is the spray head and compressed air. You can use a paper cup for a dispenser as demonstrated above

POPULAR MECHANICS



KEEP SANDPAPER WET while removing scratches. That's what the bucket's for. Keep your eye on the scratch and stop sanding as soon as it disappears



AFTER SCRATCH IS OUT, buff area by hand to finish the repair. Any soft cloth and one heck of a lot of elbow grease should wrap up the job for you



TO ELIMINATE ABOVE STEP, you can buff the entire boat to restore gloss to all dull surfaces. An electric buffer is the ticket for this task

MARCH 1971

common problem for fiberglass boat owners. To get rid of this, first wash down the area with acetone or lacquer thinner to remove grease and grit that can cause additional scratches during the repair.

Now, sand the scratch with wet 400-grit sandpaper. Keep a light hand on the paper and a keen eye on the scratch so you can stop sanding as soon as the scratch disappears. If you go crazy with the paper you could sand right through the gel and have a bigger headache.

Complete the repair by buffing as described above.

- *Handling crazed cracks.* Crazed cracks in the gel coat often look like a spider web. To remove them, block-sand the area with 100-grit sandpaper.

All crazings must be removed. If not, what's left will spread after the boat has been returned to use and you'll be back where you started.

As you sand, try not to make ripples and indentations in the gel coat. If you're lucky and none appear, you can spray or brush on the gel coat after sanding is completed. However, rippling the gel coat is often hard to avoid when you sand crazed cracks. Thus, you'll have to apply plastic repair putty over the area, then sand, buff and finish as described for gouges.

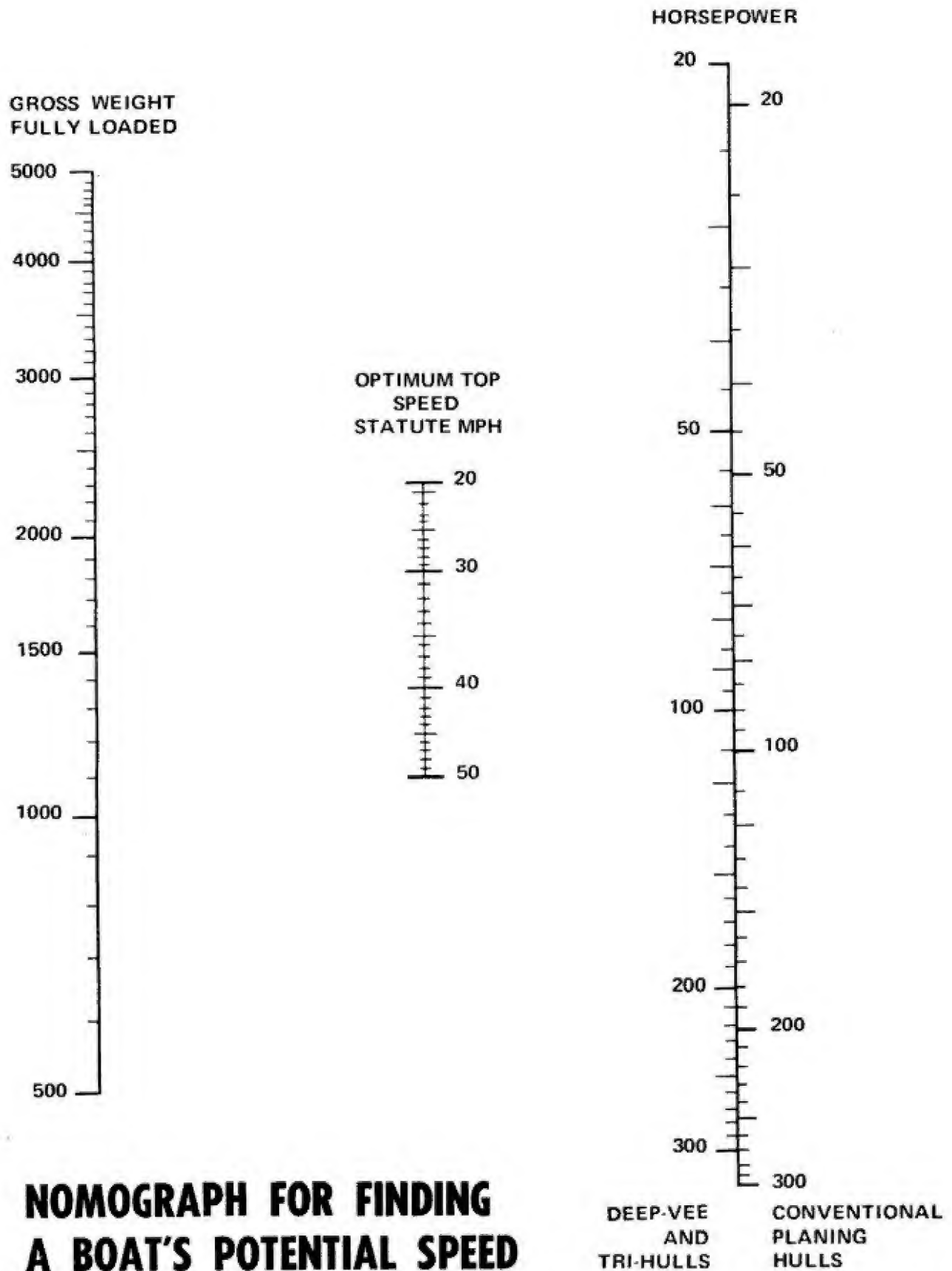
- *Getting rid of wrinkles.* An owner may find gel coat wrinkles over his new boat, a result of sloppy manufacture. Wrinkles look like the "hilly" region of a topographic map.

With a putty knife, scrape off as much wrinkled area as you can. Remove the rest with 100-grit sandpaper. Sand until smooth, and follow by swabbing thoroughly with acetone or lacquer thinner.

Mix a quantity of fiberglass plastic repair putty and apply smoothly with a rubber squeegee. Cover the area with cellophane as explained above until the putty cures. Sand the spot again with (in order) 220, 400 and 600-grit paper

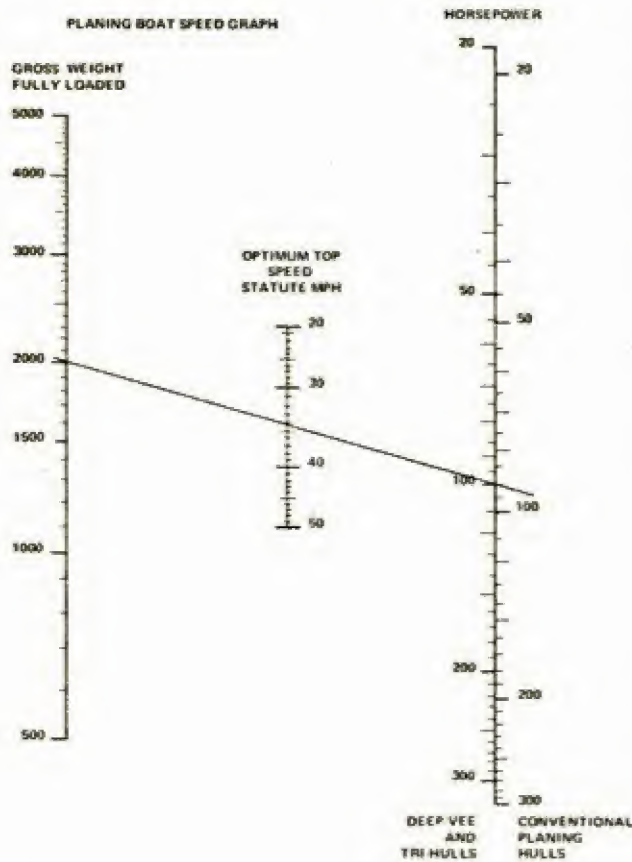
(Please turn to page 206)

How to Figure Your Planing Speed From





Hull and Horsepower



EXAMPLE: A 100-hp engine mounted on a 2000-pound (gross weight) deep-V boat should give 35-mph speed

By **JIM MARTENHOFF**

KNOWING the fully loaded gross weight of a planing boat, and the horsepower, allows you to compute the probable optimum speed—assuming the engine is tuned and delivering its rated hp, correct propeller is fitted, and the boat is properly trimmed.

Here is a nomograph, or slideless slide rule, that tells you what top speed you can expect from your boat. If you know the hp, all you have to do is figure the gross weight, *fully loaded*.

Using a straightedge, connect the gross weight with the hp. Read optimum top speed at point where straightedge intersects speed scale in center.

The hp scale, you'll note, is in two parts: conventional planing hull hp on the right side; deep-vee and tri-hull hp

on the left. (Boats with complex bottom configurations are not ordinarily as efficient as hulls with flat bottoms aft, require slightly more power to attain the same top speed.) Timing your boat over a measured distance and comparing true speed with that obtained from the nomograph does two things:

First, if you fall badly below what you expected, you may have an engine not putting out its rated power, a poor propeller—you may need more pitch—or your boat may be poorly trimmed out for peak performance with, perhaps, too much weight forward.

Second, the nomograph serves as a "rating" of powerboat efficiency, including hull design. If actual speed on a measured mile equals the speed obtained from the scale, then the boat rates at 100 percent, or par. Most boats will reach top speeds at 90 percent of that obtained from the scale, or better.

Boats rating much less than 90 may have performance or even design problems. A rare boat will exceed 100.

The nomograph can be used when buying a boat, providing a clue to what hp you need for the top speed you want. Connect weight with top speed required, read minimum necessary hp where straightedge intersects hp line.

For heavier inboards with weight and hp above those on the scales, take 10 percent to use table. Example: 9000-pound boat, 420 hp; use 900 pounds and 42 hp. Answer from nomograph is optimum speed for that boat.

Forty miles per hour is a sort of "barrier." Efficiency tends to improve sharply above 40 mph, as the boat's bottom "breaks out," gets air under it, has less wetted surface and therefore less drag. It would not be unusual for boats exceeding 40 mph to rate above 100 in performance efficiency. ★★★

WATER 'TOYS'

Whether you want to explore the Florida Keys or merely get out to your mooring, inventors have come up with some pretty wild ways to do it!

WANT A BOAT that's more like a motorcycle or snowmobile? The Hunter Scooter Ski (left) may be just your cup of tea. Or Bombardier's jet-powered Sea-Doo or Turbo Marine's Scorpion. Hydro-Cycle's Barracuda is outboard version of same stable design

FLEET OF YAK-YAKS shows one way to get there. Whether you're a pedaler or a paddler, Fleet Products Co. (1920 E. Pomona St., Santa Ana, Calif. 92705) promises to have something for you. How about a fiberglass Yak-Yak water coupe (top) 10 feet 3 inches long, weighing 250 pounds and with 800 pounds capacity? Or a plastic un-sinkable Yak-Yak Kayak (bottom) just 10 feet long and only 50 pounds? If you're still not satisfied and want something else in a pedal-boat, try the Mustang (fiberglass) by Dolphin Products, Inc., Box 4220, Clearwater, Fla. 33518 or the Aqua-Bike (marine aluminum) by Kayot, Inc., Mankato, Minn. 56001. If you're in the market for either a pontoon boat or a canoe, Kayot has a full range of choices



THIS MAY NOT LOOK LIKE A SKI BOAT, but the Bronco will do 31 mph with a 20-hp engine and is unsinkable even if you flip it! Write Perfection Boats, 4044 N.E. 5th Terrace, Fort Lauderdale, Fla. 33308. Similar designs are the Firefly (FF 300) from Grewe Products and the Scat-A-Boat from Allen-Hayosh

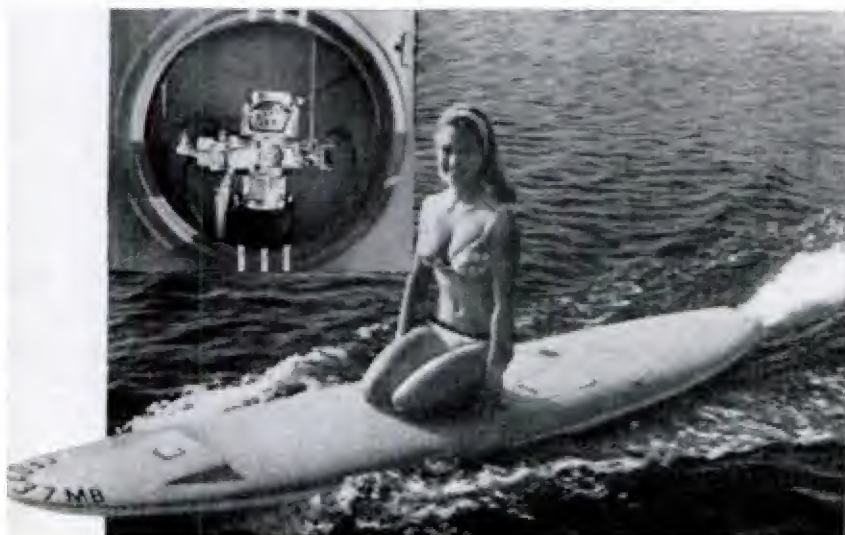
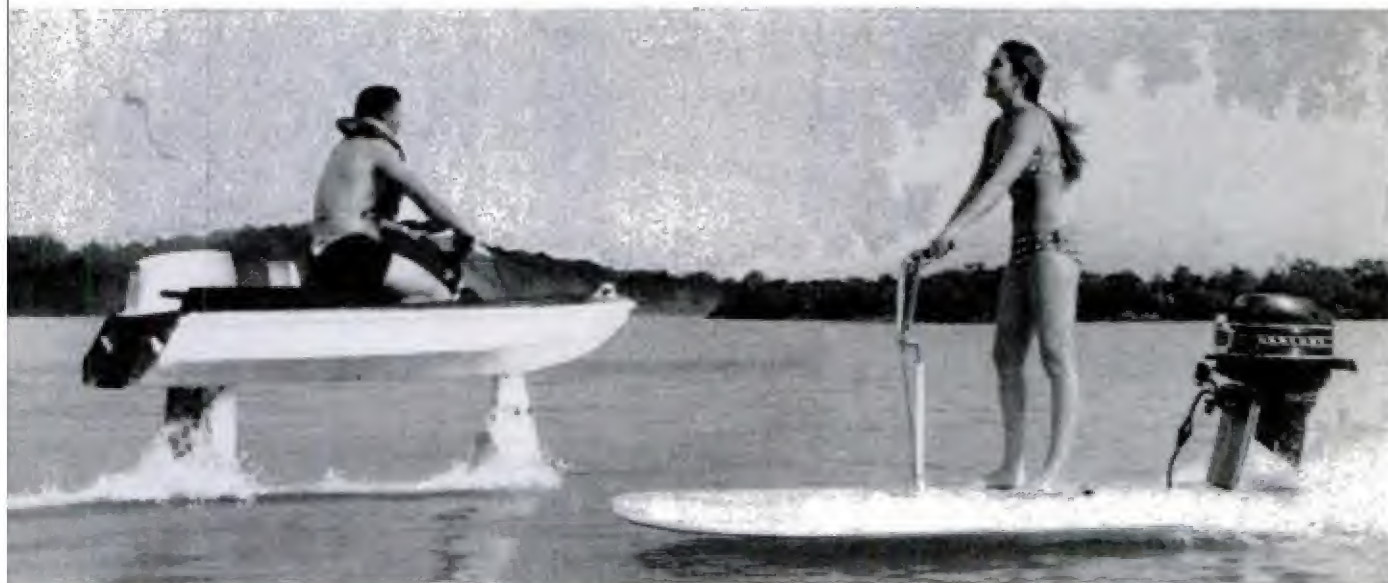
WOULD YOU BELIEVE A "SEASAUCCER"? That's what inventor Charles Jennings calls this whatzit. Actually, round boats have been used in the Orient for centuries; only Westerners have trouble steering them. Weighing 55 pounds with a bottle-fed turbine engine for power, the 'Saucer holds 700 pounds

POPULAR MECHANICS



BOY MEETS GIRL (below). He, on Britain's new Hi-Foil runabout; she, on an Aqua-Glider (Box 306, Glassboro, N.J. 08028.) With a 7.5-hp outboard, Aqua-Glider has a tested top speed of 22.7 mph—not bad for mechanized surfing! Similar is the Aero-skimmer from Leisure Products, Menlo Park, Calif.

MINI-MANTA (left) and Sea Scuta (above) are made especially for the growing underwater recreation trade. Think of the fun you could have at a crowded beach! The Mini-Manta tows a diver up to five knots for four hours; the more compact Sea Scuta gives you two hours at three knots. The latter from Underwater Ways, 173 Bleecker St., New York, N.Y. 10012, for \$375; the Manta for less than \$1000 from Leisuredyne, Inc. Another diver propulsion unit (operational to 300 feet) is the DPV MK-1 from Farallon Industries, 1333 Old County Rd., Belmont, Calif.

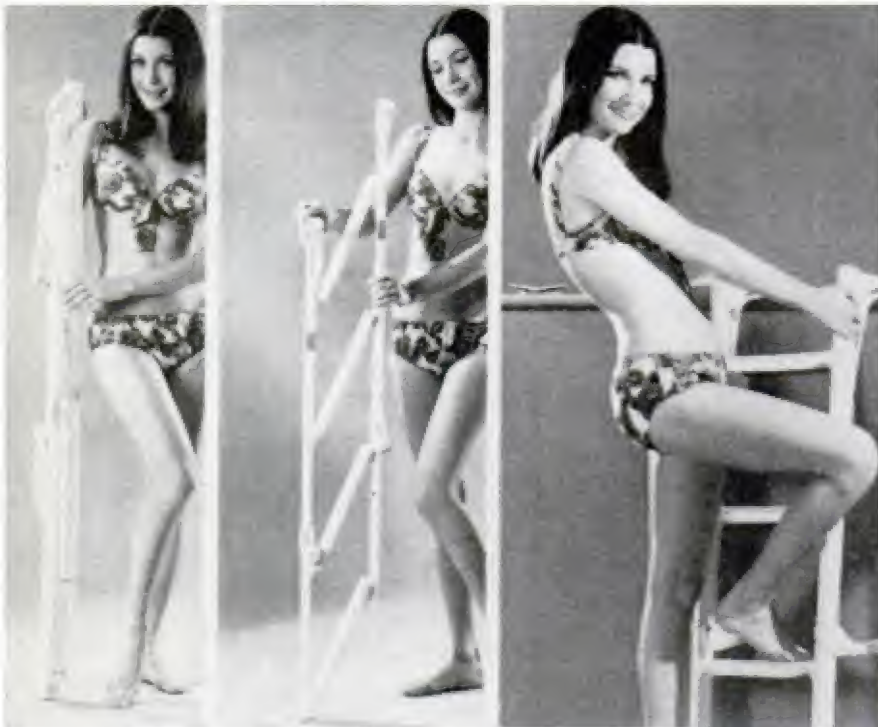


WHO NEEDS SURF TO SURF? This gal (left) doesn't. She has a single-cylinder loop-scavenged, two-cycle, 6.2-hp engine for her Jet Board (9255 Sunset Blvd., Los Angeles, Calif. 90069.) Priced at \$495, this water-jet propelled board runs four hours at 10 mph with such comely cargo. And if she falls off, a safety switch disengages the throttle, so the board won't go to sea without her. Skimmer (Western Recreational Products, Ltd., 5545 97th St., Edmonton 85, Alta., Canada) offers two Chrysler engine options of 3.5 and 7 hp to drive a slightly bulkier board up to 20 mph. Also using waterjet principle, but in kind of toboggan, are Aqua-Jet from Aquasonics, Inc., Rochester, N.Y. 14613, and Aquadart from Leisuredyne, Inc., 166 Ridgedale Ave., Morristown, N.J. 07960.



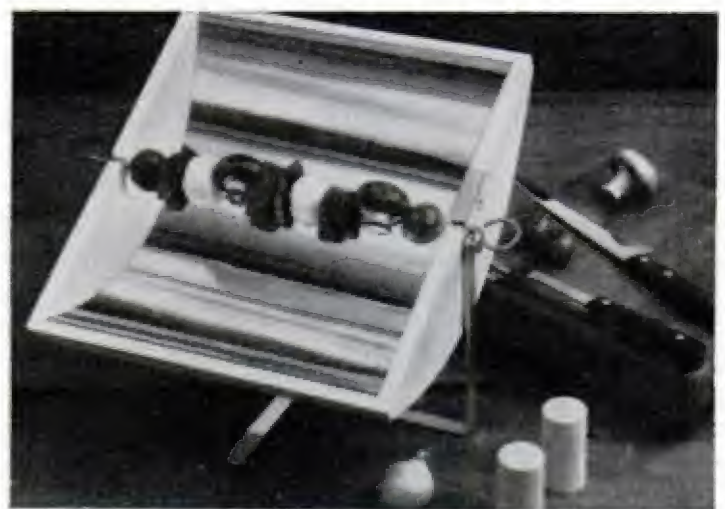
New Boating

They'll help you to improve your on-the-water living



STOWABLE BOARDING LADDERS by Mayfair Marine Corp. (1217 Combermere, Troy, Mich. 48084), made of Union Carbide's "structural foam," are so light they float, yet support 500 pounds. They won't rot or rust and they resist marine growth.

FOR NIGHTTIME BOATERS Allan Marine, Box 120, Deer Park, N.Y. 11729, has a portable set of battery-operated running and emergency lights for bow, stern and waterproof flashlight use.



SOLAR COOKER lets sun's rays do the cooking in minutes with this 13 by 13 by 4-inch unit. Davis Instruments, 857 Thornton St., San Leandro, Calif.

PROTECT YOUR BOAT while trailering with a Transom Hold Down made up of chains, hooks, tension springs and lock. Dutton-Lainson, Hastings, Neb.

Products

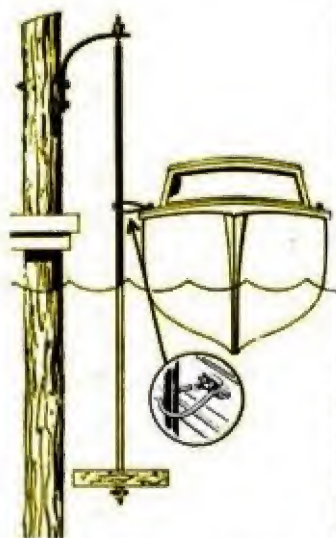
By ROB KINSON



PORTABLE CUDDY CABIN for cartopper stores in compact pouch. For 12 to 14-ft. boats. Easily put up to protect from sun and rain. From Convert-A-Top, 1827 Los Robles Blvd., Sacramento, Calif. 95838. Price: \$49.95.

BE COOL ABOARD YOUR CRUISER with Aqua-Therm Mark II, water-cooled marine air-conditioner (top right), Repco Products, 7400 State Rd., Philadelphia, Pa. 19136. \$300.

NO MORE METAL NOISE or rust with Gas-Mate, portable 6-gal. polyethylene fuel tank with fuel gauge, bleed valve (right). \$15.95 from Zurn Industries, Erie, Pa. 16512.



EVEN WITHOUT TIDES, heavy winds and rain can drastically alter water levels and damage your boat. Moor Master Div. of Tomlinson Industries has a device—two steel arms and a concrete block—to hold a pair of plastic-covered steel cables so boat rides free a foot from dock. Write Moor Master Div., 13700 Broadway, Cleveland, Ohio 44125.

FOR ANY TIE-DOWN JOB, this weather-resistant strap will stretch from 4 to 36 inches. It adjusts four ways, costs 89 cents. Tempo Products, 6200 Cochran Rd., Cleveland, Ohio.



BUILD THE 
Yellow Jacket
FOR \$400.

Here's a hot little air-cushion vehicle that hovers at 5 inches and goes up to 50 mph.

By **ROBERT Q. RILEY**

PLANS AVAILABLE. A set of complete plans and instructions for building the Yellow Jacket can be obtained by writing Popular Mechanics Magazine, 224 W. 57th St., New York, N. Y. 10019. Enclose \$15. Specify Yellow Jacket plans.





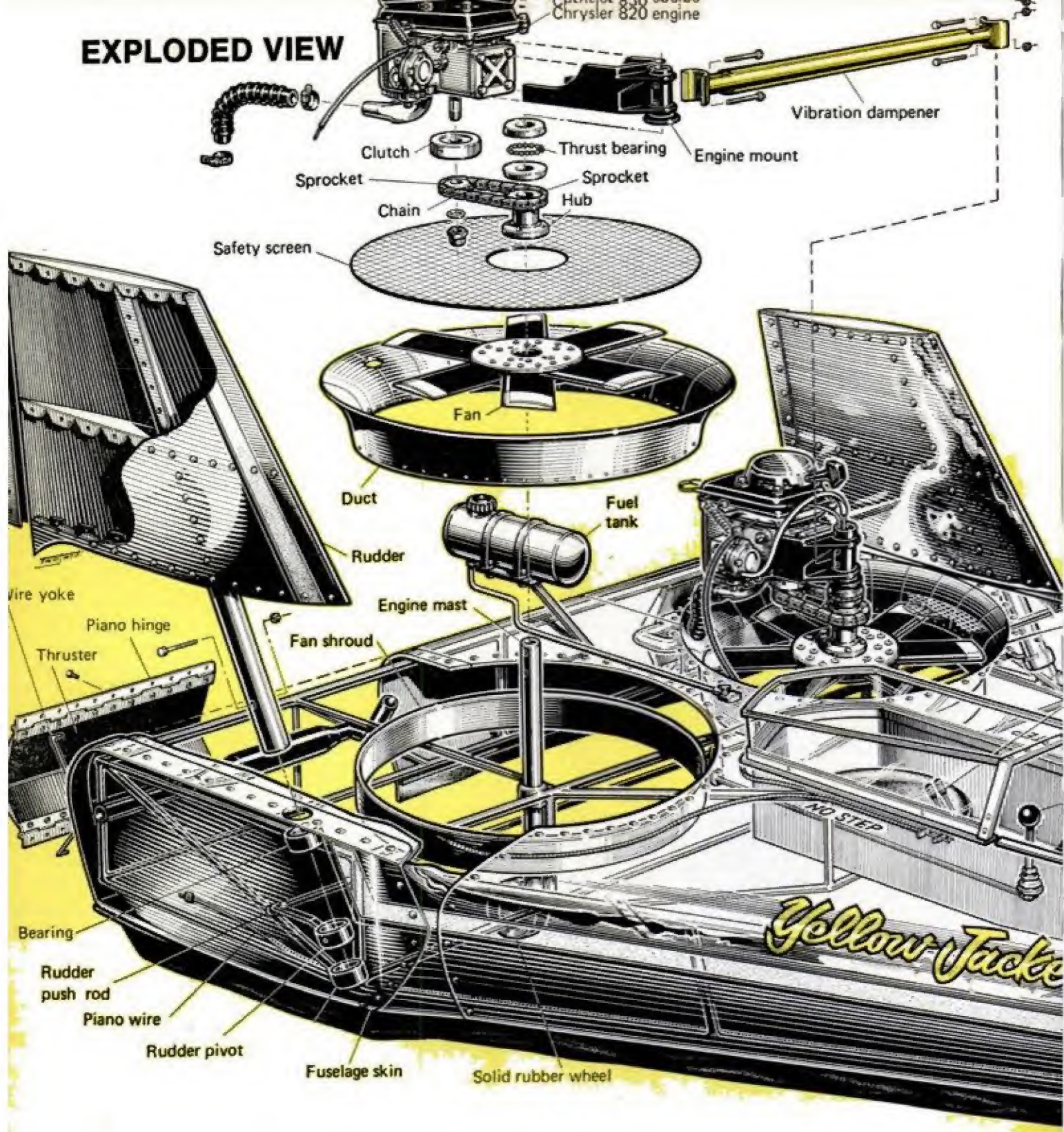
FLYING THE YELLOW JACKET is quite an experience. You first start the two go-kart engines using the rope starters. Then, after letting the engines warm up a bit, you climb aboard. At about one-third throttle the skirt suddenly inflates like a balloon, and the craft pops up about 5 in. and sits on the edge of the skirt. At about half to three-quarter throttle you are airborne. Once contact with the ground is lost, you are instantly aware of the complete absence of friction. Simply by leaning one way or the other, you can make the Yellow Jacket spin around in a circle, move backwards, sideways, or perform a combination of all these. At low speeds, you use the pedal-operated thrusters for steering; the rudders don't become effective until you reach 20 to 25 mph. At that speed the craft is very stable and the only way to change direction is with the rudders. Over water the craft is no speed demon, but take her over open, flat land and she will really sail.

Yellow Jacket is a result of the engineering know-how of Eugene Gluhareff, former helicopter designer and project engineer at the Sikorsky Aircraft Co.

"The failing with most small air-cushion vehicles," Gluhareff says, "is that the air is not used efficiently. Many times the builder will employ a standard



EXPLODED VIEW



BUILDING the Yellow Jacket is a lot easier than it appears, and the craft is pure fun to operate. The plans offered (see page 126) include a pattern for making the prop. If you lack a router or the patience, you can have a prop maker turn it out. For speediest reply when ordering plans, address your envelope to PM's Reader Service Bureau 128



Kill switches

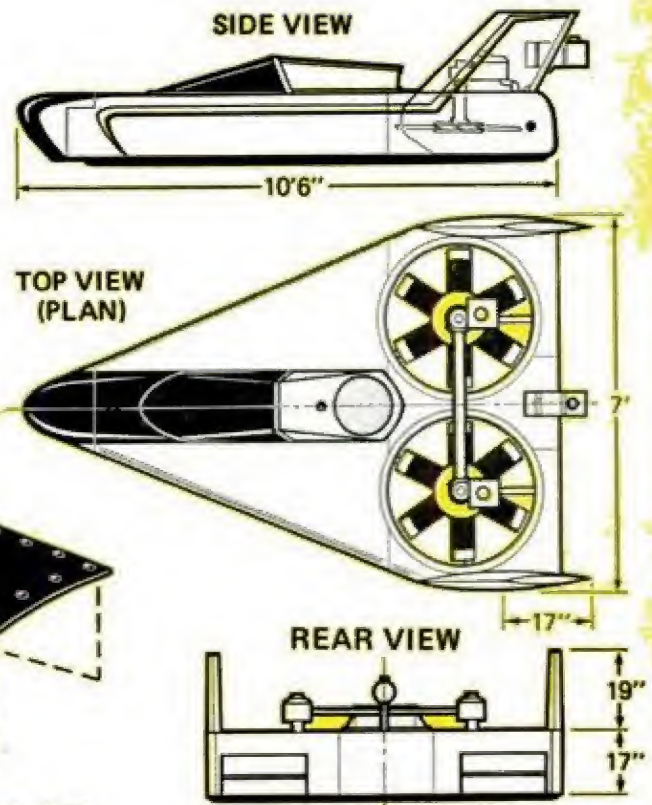
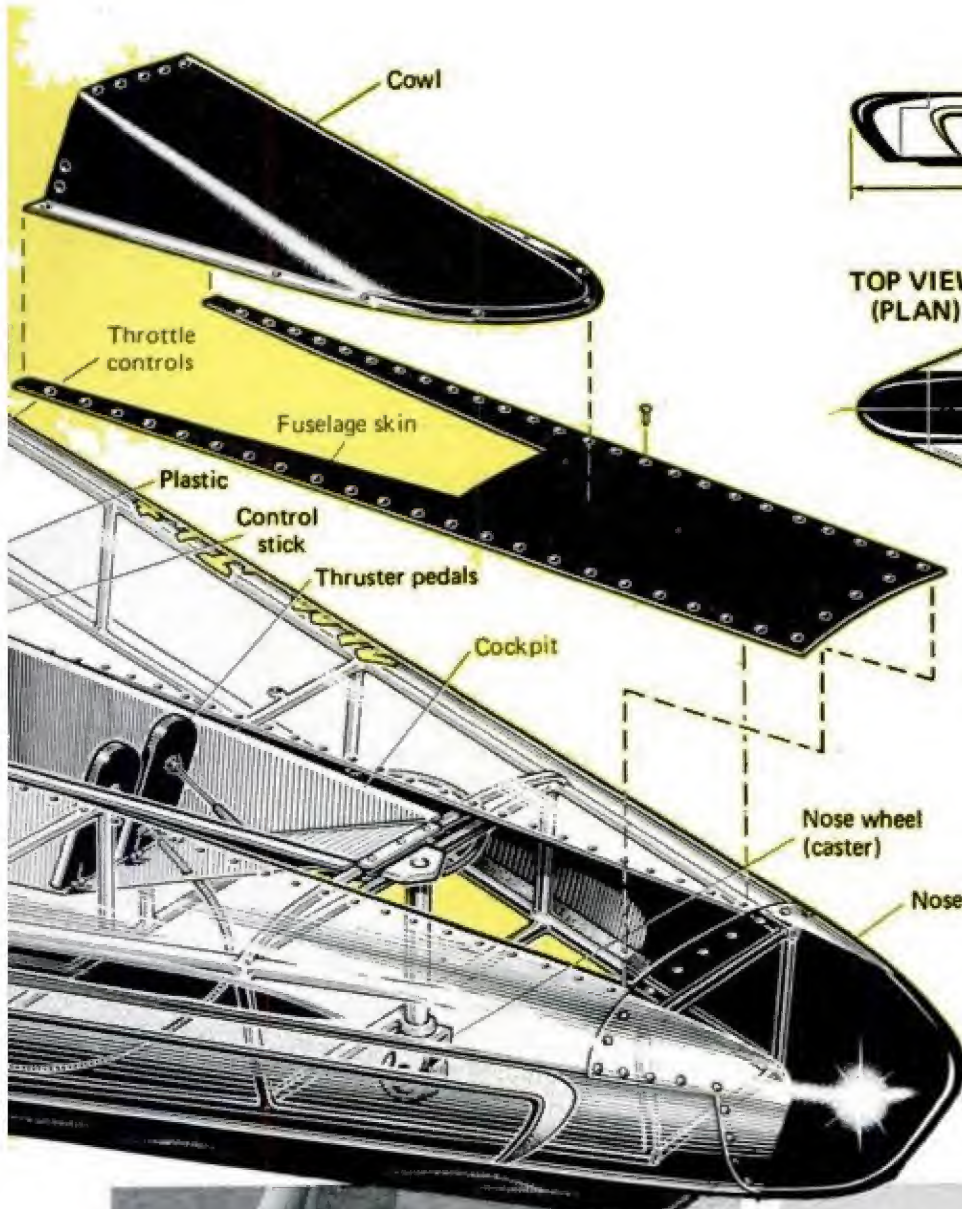


PHOTO ILLUSTRATION

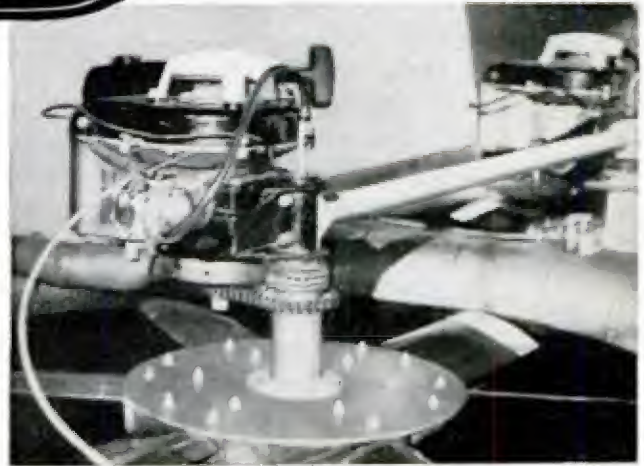
propeller is great until you put it next to the ground. But this creates a strong back-pressure and the propeller loses most of its efficiency." So he started the Yellow Jacket from scratch, designing two very efficient compression fans around the powerful Chrysler 820 go-kart engine. For more lift, he cambered the fan blades like airplane wings. At a 3600-rpm operating speed, the blades act as miniature wings

moving at over 300 mph. "Finally," he continued, "I designed the fuselage in the shape of a flying wing, which creates lift as it moves through the air." (Ed. note: This accounts for increased altitude as Yellow Jacket gains speed.)

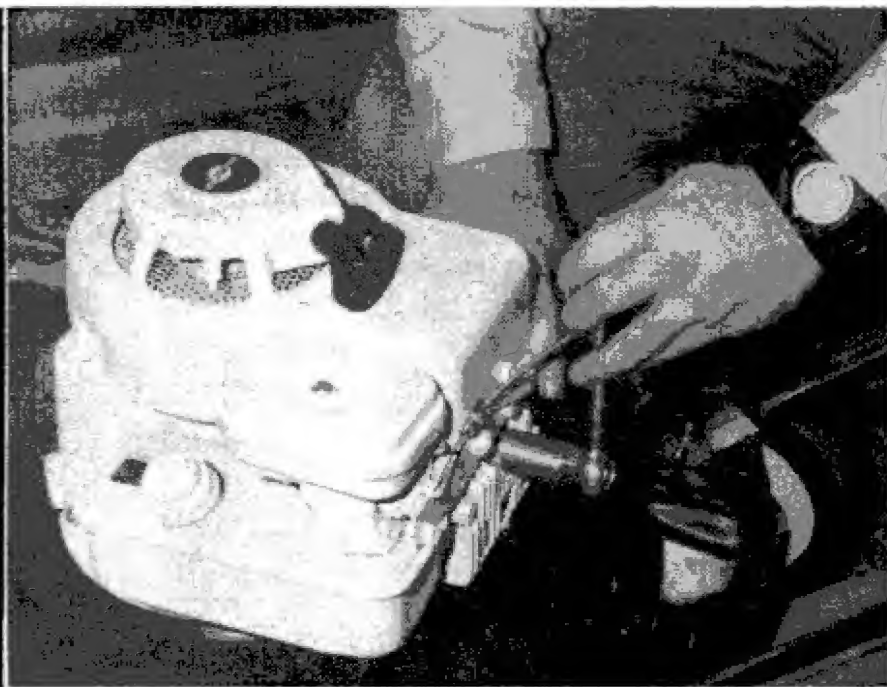
To build the Yellow Jacket, Eugene used readily available materials throughout. The frame is, principally, 7/8-in. dia. *(Please turn to page 182)*



Technical Art Created by Peter Trojan, Based on Drawings by Dave Carey



How to Service Small Engines



By MORT SCHULTZ

Illustrations by Fred L. Wolff

SPARKPLUG IS ONE OF FIRST CHECKS to make when troubleshooting. When replacing, seat by hand, give half turn with socket

THIS FIRST INSTALLMENT of a two-part article, to be continued next month, deals with troubleshooting, repair and maintenance of single-cylinder gasoline engines. These engines power yard and garden equipment—self-propelled and riding mowers, tillers, leaf blowers, sweepers, tractors, chain saws, trimmers and snow blowers.

Let's start by defining terms. *Troubleshooting*, the single most useful skill to master, means to zero in on a malfunction. Before you can solve a problem, you must find its cause. Even if you don't want to tackle the repair, knowing what's causing the problem allows you to be specific in dealing with a mechanic, thus assuring yourself that unnecessary repairs won't be made. Replacing parts and making adjustments to solve a problem will be considered as repairs.

We won't get into engine overhaul. Practically every case of engine failure can be resolved with minor repairs; we'll concentrate on those.

Maintenance, which includes tune-up, is the care you give a small engine to minimize the chance of breakdown. Replacing parts and making adjustments to forestall a breakdown will be considered as maintenance.

Two other terms you will encounter are *two-cycle* and *four-cycle*. Your single-cylinder engine is one or the other.

Two-cycle engines take in fuel, com-

press and ignite it, and exhaust waste gases in two strokes of the piston—up and down. The ignition (power) stroke occurs during every revolution of the crankshaft.

Four-cycle engines accomplish intake, compression, ignition and exhaust in four piston strokes. If you're not very well acquainted with small engines, here's how to tell two from four-cycle quickly: You mix oil with the gas for a two-cycle; a four-cycle has an oil sump and filler pipe. If your engine is made by Briggs & Stratton, Kohler or Wisconsin, it's four-cycle. If it's a Jacobsen engine, it's two-cycle.

Jacobsen, incidentally, is one of the few manufacturers that makes two-cycle engines for its own equipment. However, where four-cycle engines are used in Jacobsen mowers and other equipment they are made by other companies, such as Lauson-Tecumseh. The manufacturer of the equipment and the manufacturer of the engine are not usually the same. So check the nameplate attached to the engine.

Two-cycle engines used in Lawn Boy mowers are manufactured by the company that makes the mower—Outboard Marine Corp. But Lawn Boy riding mowers use either a Briggs & Stratton or Lauson-Tecumseh four-cycle engine.

If your engine is made by Clinton or Lauson-Tecumseh, it could be two- or four-cycle.

Engines that power chain saws, such as

Be your own serviceman. You can handle most small engine repairs. Here's the guide you need to insure quick-starting, smooth-running gas engines on your yardpower equipment.

McCulloch, Homelite and OR (many Sears chain saws have OR engines) are two-cycle.

Troubleshooting. The following is a list of the major problems that affect small engines:

1. Engine doesn't start or is hard to start.
2. Engine overheats.
3. Engine vibrates excessively.
4. Engine stops running and won't restart.
5. Engine misses under load or lacks power.
6. Engine knocks.
7. Engine surges (gallops).
8. Engine backfires.

Each of these problems, with the exception of engine knock and excessive vibra-

tion, is caused primarily by trouble in one of four areas: ignition, sparkplug, fuel or compression. The sparkplug is, of course, part of the ignition system. However, it's considered separately for two reasons: First, because a bad or "wrong" sparkplug is often a cause of small engine failure; second, because it may be the result of a more serious problem that will not be resolved by simply replacing the plug. An examination of the sparkplug will show what that problem is.

When your engine gives trouble (other than knocking and excessive vibration) first do the following in the sequence given:

1. Check ignition output

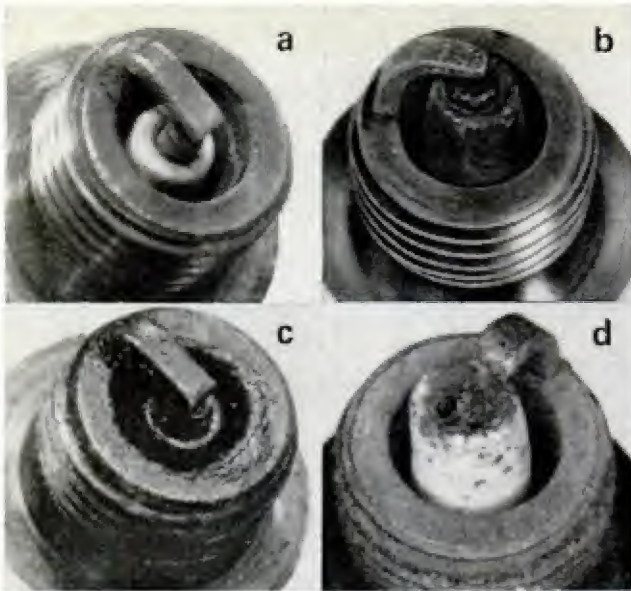
Most small engine problems are caused



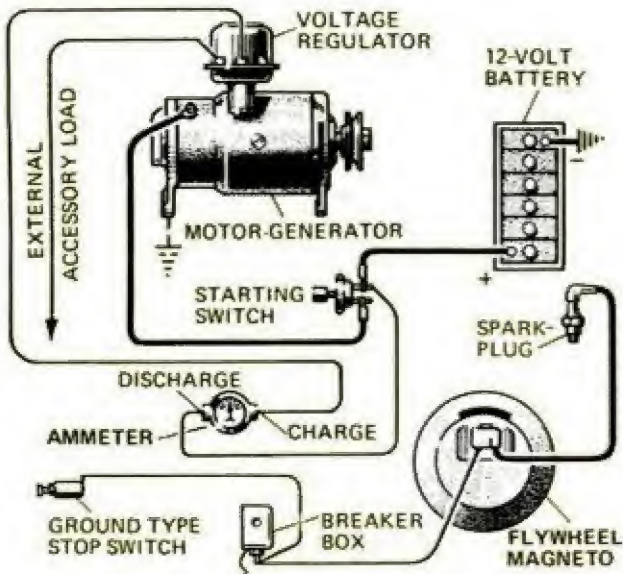
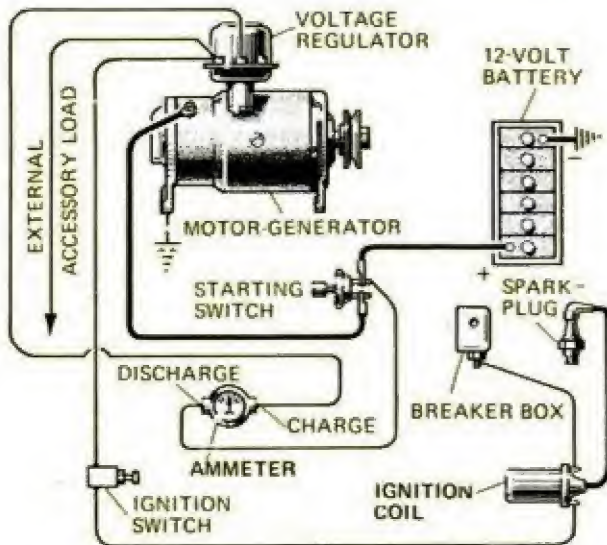
HARD STARTING of two-cycle engine is often the result of not using gas-oil mixture that's specified
MARCH 1971



FOUR-CYCLE ENGINE OIL is critical in preventing cylinder scoring. Use what manufacturer suggests



SPARKPLUG CONDITION tells a tale: (a) Normal wear with grayish deposits; (b) fouled with carbon deposits; (c) oil-fouled, and (d) burned electrodes



IGNITION SYSTEM of most engines has a magneto. Ignition coil system (top) is generally found on the large four-cycle engines used on garden tractors

by a breakdown in the ignition system. There are two basic types: magneto and ignition coil systems.

Most single-cylinder small engines use magnetos. Exceptions include some of the larger horsepower Wisconsin, Kohler and Lauson-Tecumseh four-cycle engines that are used in garden tractors. They have an ignition-coil system.

The difference between magneto and ignition coil, simply stated, is that once the engine is running, a magneto makes its own electricity. A properly operating magneto system provides about 15 kilovolts to the sparkplug.

In the ignition-coil system, a regular automotive-type ignition coil, which is basically a transformer, replaces the magneto. A modern system has a 12-volt battery (charged by an alternator) providing current to the ignition coil which steps the 12 volts up to approximately 25 kilovolts at the sparkplug.

Both magneto and ignition coil systems employ breaker points which act as a switch to concentrate full voltage at the sparkplug at the exact time that current is needed to fire the fuel mixture. A relatively new innovation used on some garden tractors having Wisconsin, Kohler and Lauson-Tecumseh engines is breakerless ignition, which employs solid-state devices instead of mechanical breaker points.

Breakerless ignition provides current approaching 50 kilovolts at the sparkplug and the timing of the spark is permanently set. With breaker points, timing can get out of adjustment, causing an engine problem until it is reset.

To test a magneto system, buy a 14-mm or 18-mm sparkplug at a gasoline station or automobile parts supply store. Open the electrode gap to $\frac{5}{32}$ to $\frac{7}{16}$ in. Remove the high-tension lead from the engine sparkplug and attach it firmly to the test plug. (The engine plug can stay in place while the output test is being conducted.)

To avoid being shocked during this test, do not hold the test plug or lead in your hand. Instead, place the plug on the engine next to a clean ground, such as a bolt. The plug can be kept from slipping by placing it beneath a cable, such as the choke cable, or by attaching it with a vise clamp.

Crank the engine. If spark jumps the gap, the magneto output is A-1—ignition is not causing your engine problem. If there is no

spark, the engine problem is being caused by a breakdown in ignition. The magneto will probably have to be disassembled and each part tested. How and for what will be discussed next month under *repairs*.

Why use a separate plug for testing magneto output? Why not just pull the plug from the engine and use that? Because the wide gap of the test plug gives a more accurate indication of magneto output.

A 14-mm sparkplug gapped to .028 in. requires a magneto output of only 7 kilovolts for spark to jump the electrode gap. (Most single-cylinder small engines use 14-mm sparkplugs.) But when you open the gap to $\frac{3}{32}$ to $\frac{3}{16}$ in., about 10 kilovolts are required for a spark to jump the gap.

A magneto in good condition supplies approximately 15 kilovolts to a sparkplug. Thus, if your magneto cannot provide a wide-gapped test plug with sufficient voltage to make spark, it tells you that the magneto has broken down or is in process of doing so.

A less accurate indication of output is given with the test you have to employ for the ignition coil system. Conduct the test in the same manner as with a magneto system, but use the engine's sparkplug instead of a test plug.

The ignition coil system is supposed to put out about 25 kilovolts. The comparatively small amount of voltage required to make spark with a wide-gap test plug doesn't justify use of this plug for the test.

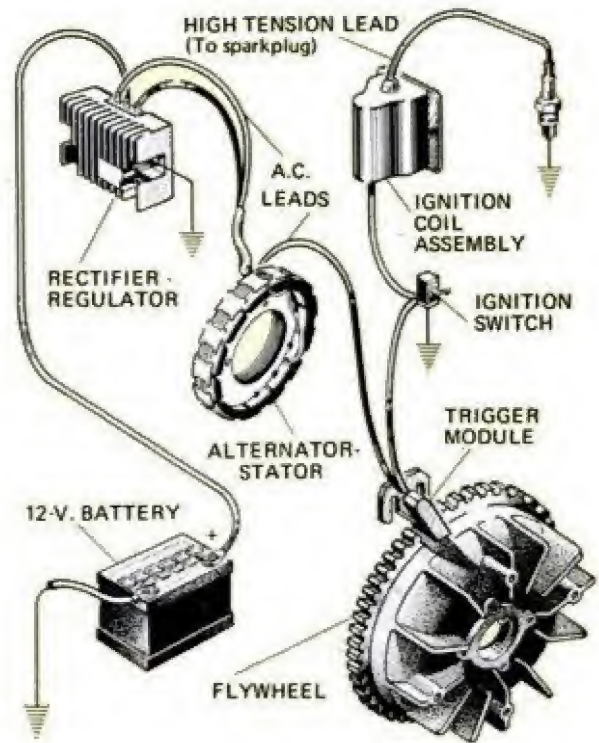
If spark occurs as you crank the engine, you can assume for the time being that the ignition system is okay. However, if other tests (sparkplug, fuel and compression) show these areas to be in good condition, then suspect ignition trouble and come back to it. If spark doesn't appear at the plug, try a new plug before ripping into the ignition system.

For solid-state ignition you'll need a spark-intensity tester to check a breakerless system. Spark occurs so rapidly that you can't see it jump the plug gap. Grounding the plug puts a strain on solid-state components and may damage them. One company that makes an intensity tester—Snap-On Tools—sells it for about \$7.50.

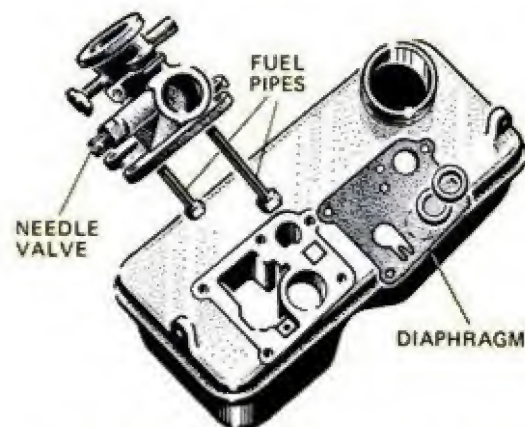
To use it, disconnect the lead from the sparkplug and attach the test instrument's lead to the cable's metal terminal. Touch the point of the test instrument to ground



BREAKERLESS IGNITION SYSTEM must be tested with a spark intensity tester connected to the plug lead



SOLID-STATE IGNITION on some Wisconsin, Kohler and Lauson-Tecumseh tractor engines uses electronic devices that eliminate breaker points. The timing is permanently set and will need no adjustment



DIAPHRAGM-TYPE CARBURETOR is directly coupled to the fuel tank. When fuel stoppage seems to be the cause of trouble, check screens in the fuel pipes



FUEL REACHING CYLINDER? Squirt some in plug hole, replace plug. If engine starts, then stops when this has burned, fuel line or screens are blocked

as someone cranks the engine. If the test light flashes, the ignition system is okay.

2. Check sparkplug condition

If your engine won't start, is hard to start, or misses or lacks power, check the sparkplug. Get a new one if you find a cracked insulator, burned electrodes or heavy carbon deposits.

Make sure that electrode gap conforms to the maker's specifications. For two-cycle engines, gap is set at .028 to .033 in.; for four-cycles, it's .025 to .028 in. Check your engine manual.

Critical examination of a plug's firing end can lead you to the cause of a problem. Here are some most common conditions and what they mean:

- *Normal wear.* If the sparkplug has brown or grayish-tan deposits and there is some electrode wear, the plug is wearing normally. Clean off deposits with a small wire brush, file the electrodes square and bright with an ignition point file, set electrode gap with a sparkplug feeler gauge, and reuse the plug.

If the plug shows extreme electrode wear and a pitted insulator, it's worn out. Get a new one.

- *Carbon fouled.* A carbon-fouled sparkplug will have dry, fluffy black deposits on the tip. This is the usual result when the engine is fed an over-rich fuel mixture. It's caused by overchoking, by a clogged air cleaner restricting air flow to the carburetor, or by an incorrect fuel-mixture adjustment.

Another reason for a carbon-fouled plug is poor ignition output that results in a reduced voltage condition to cause mis-firing. Check for bad breaker points, a weak coil or condenser, or a worn ignition cable.

- *Oil-fouled.* An oil-fouled sparkplug spells internal engine trouble in the form of worn piston rings or valve stems.

- *Burned electrodes.* The chief cause here is an overheated engine; also check for improper ignition timing and a lean fuel mixture.

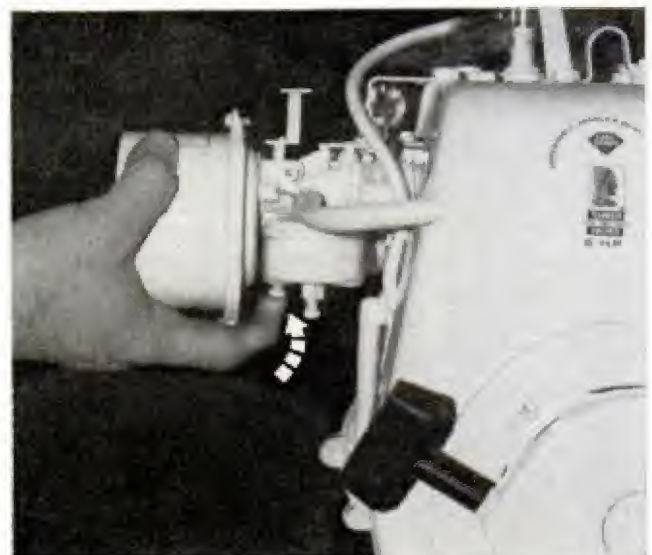
To install a sparkplug, seat it by hand and then turn it one-half turn with a socket wrench.

3. Check fuel system

Make sure that fuel is getting to the carburetor and, if so, through the carburetor into the cylinder. For a quick check, crank the engine and then remove the sparkplug. If the tip of the plug is wet with fuel, your engine problem is being caused by something other than a fuel-system malfunction.

A more accurate way to see if the fuel system is functioning is to squirt some fuel into the cylinder from a clean, trigger-type can. Only two or three squirts are needed. Insert the sparkplug and try to start the engine. If the engine starts, runs for a few seconds or so, and then stops, trouble is indicated in the fuel system.

Now, where's the stoppage—ahead of the carburetor or in it? Many carburetors



FUEL STOPPAGE IN LINE or carburetor? Press drain valve. If gas doesn't leak out, check line and tank

with bowls have a drain valve in the base of the bowl next to the main adjustment screw, which is larger. Press the drain valve. If fuel doesn't leak out, this indicates there's an obstruction in the fuel tank or fuel line.

If there is no drain valve and the fuel line connects the fuel tank (or fuel pump) to the carburetor inlet, simply unhook the line at the carburetor. If fuel dribbles out, it is getting to, but not through, the carburetor.

If your fuel system is the type in which carburetor and fuel tank are coupled together, fuel is fed directly from tank to carburetor through pipes attached to the carburetor. This is done by the creation of low pressure in the carburetor while the piston is moving on its downward stroke.

If the sparkplug or cylinder-loading test indicates a fuel failure, the carburetor will have to be disconnected from the fuel tank. Check the screens in the fuel pipes to determine if they are clogged. If they aren't, it's evident that the carburetor needs overhauling.

Engine trouble will also result if the fuel system floods the cylinder. If the engine doesn't start after cranking, examine the tip of the sparkplug. If it's wet with fuel, either the engine is flooding or an ignition or compression failure exists. Make ignition and compression tests to determine the problem.

4. Test compression

If your engine has an A-1 ignition and fuel system, and a brand-new sparkplug,



FUEL STOPPAGE AT CARBURETOR? Unhook fuel line at carb. Fuel flows? It's getting to, not through, carb
MARCH 1971



MINIMUM COMPRESSION? Without it, you'll have hard starts, less horsepower. Only a gauge will tell

it won't do much unless it has compression. Compression is the ability of the piston to compress fuel to a point where it will ignite and burn to provide maximum power.

Compression in a single-cylinder engine is extremely important. Without the specified amount, the engine will prove hard to start and will not develop maximum horsepower.

Good compression is a result of engine "tightness." An engine loses compression when it loses its ability to seal. Leaks around worn rings and pistons, cylinder or valves, or a ruptured gasket, for instance, will cause loss of compression.

An accurate check of compression can be made only with a compression gauge. Remove the sparkplug and hold or screw (depending on the type used) the gauge into the sparkplug hole. Crank the engine several times until the gauge gives a maximum reading.

If you are working on a two-cycle engine, the reading should be at least 60 pounds per square inch (p.s.i.). If you have a four-cycle engine of 4½-hp or less, the compression reading should be 65 to 70 p.s.i. If it's above 4½-hp, minimum compression should be 70 p.s.i.

Once the problem area has been isolated, the part (carburetor or magneto, for example) may have to be disassembled and each component checked. But if you're lucky, perhaps only an adjustment is needed.

Next month's article will deal with how to tackle repairs in a logical sequence so you can do the job in the least amount of time.

★★★

How to Troubleshoot Your

SATURDAY MECHANIC

The speedometer head is a delicate instrument that can be tricky to repair, and happily it rarely fails. Most problems are with the connecting cable itself or at one end of it—and they are easily remedied

By MORT SCHULTZ



IN TRANSMISSION PINION SYSTEM, detach cable from speedometer head, then pull it from housing



TO REMOVE SNAPPED CABLE you must detach cable housing from the pinion gear at the transmission

YOUR CAR SPEEDOMETER is a delicate instrument that is taken for granted—until it starts acting up.

The instrument, which informs you how fast your car is moving (as opposed to an odometer which records the miles you've traveled), incorporates a permanent magnet, speed cup and a finely calibrated hair spring.

Lucky for you that a speedometer head seldom fails. Repairing the head requires special tools and knowledge. The professional who has both charges a pretty penny. Replacing the speedometer head costs about \$25.

Speedometer problems, however, occur most often from the coupling on the rear of the speedometer head back to the transmission (or to one of the wheels).

The speedometer cable is the one part that gives the most trouble. It transfers car speed, as represented by transmission-shaft (or wheel) rotation, to the speedometer head.

Two general systems

Speedometer systems are of two general types. In most cars, the speedometer head is connected to the output shaft of the transmission by means of the flexible speedometer cable, which is attached to a pinion gear in the transmission.

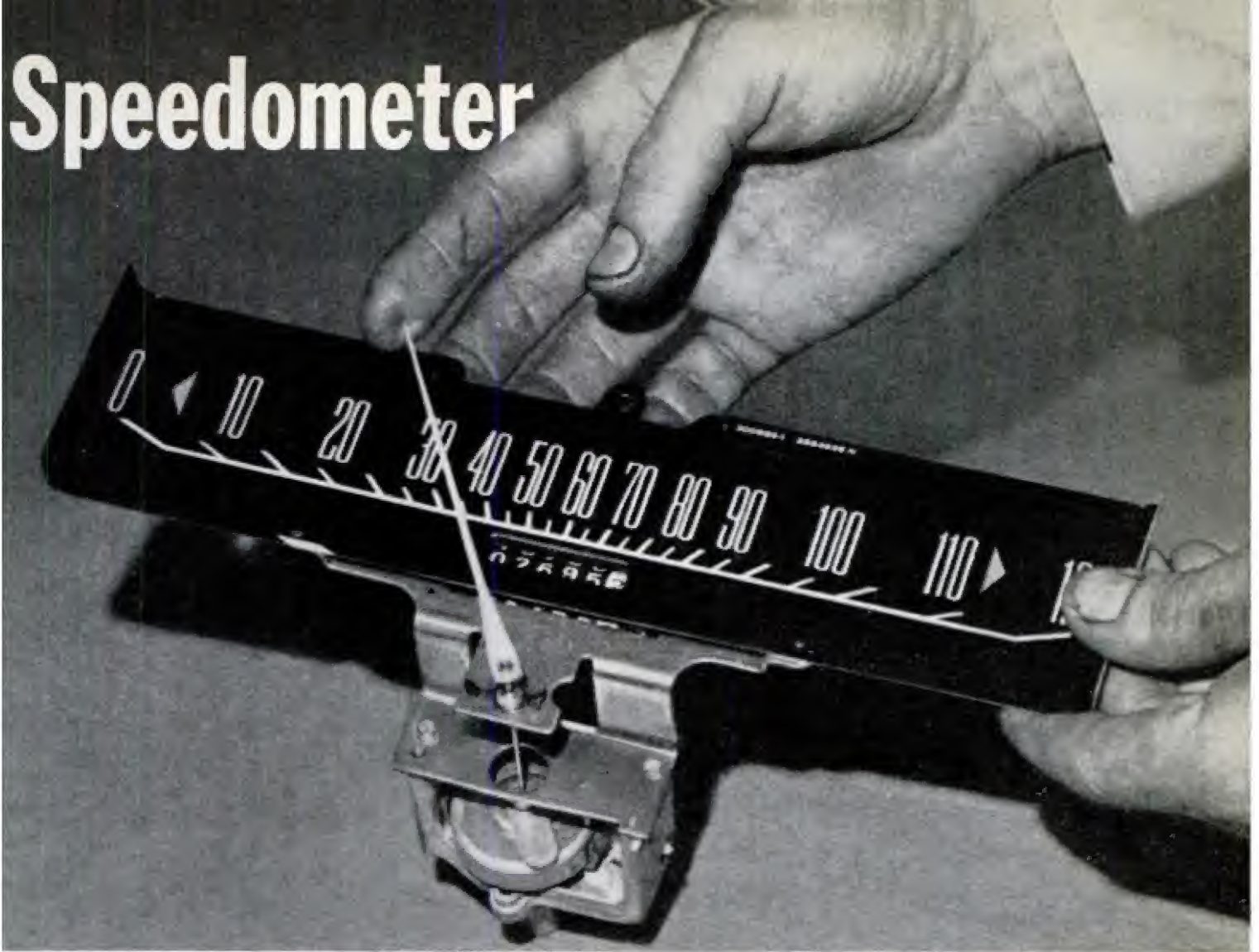
As the pinion is driven by the transmission output shaft, it drives the cable, which drives the speedometer head that registers speed. Also driven is the geared odometer, recording distance traveled. The speedometer cable is protected by an outer casing (housing), but the two parts—cable and casing—are separate.

In other cars—Volkswagen comes to mind—the speedometer and odometer are driven by a flexible cable that is attached to one of the car's wheels—usually the left-hand front wheel.

Other than this difference, both types of speedometer systems are pretty much the same.

A speedometer problem becomes ap-

Speedometer



BEFORE REPAIRING or replacing a speedometer head having a needle which hangs up, make sure that the hang-up and the resultant noise aren't due to a bent needle. All you may have to do is unbend it

parent in one of four ways: a ticking or scraping noise is heard; the speed indicator, if it's a needle, moves and then hangs up; the speed indicator doesn't hold steady when car speed is steady; the speed indicator just doesn't work.

Speedometer noise is the most common problem and usually precedes complete failure. In other words, noise coming from the speedometer probably means that the cable is in bad shape and will snap if you don't take action.

Before pulling the cable, though, make sure the cable-to-speedometer head coupling hasn't worked loose.

Disconnecting cable

There are two ways in which speedometer cables are connected to the speedometer head: a conventional coupling nut that you can tighten with a pair of pliers; or a quick-disconnect that you press in to pull the cable from the speedometer head.

The quick-disconnect replaced coupling

nuts in many 1968 and later models, but this isn't true across the board, so check your setup.

There's another problem that you'll run into at this point. How do you get to the rear of the speedometer head so you can get at the cable coupling? The way varies from car to car of even the same make and model year.

With some cars, such as the 1970 Falcon, Fairlane and Montego, you can reach beneath the instrument panel to release the cable. Try this first. It's the easiest.

With others, such as the 1970 Ford, you have to remove the upper section of the instrument panel pad and reach down behind the panel. And with still others, such as the 1970 Mustang and Cougar, you have to remove the instrument cluster.

An examination of your setup should reveal what method you have to use.

If the coupling nut is tight so that it couldn't be the cause of noise, disconnect the cable from the speedometer head and



CABLE TIP is the short portion from the end of the cable to knurled stopnut on speedometer head end. If this tip is bent, the cable should be replaced

slowly pull the cable out from its housing.

A cable that is run off the car's front wheel must first be detached from the wheel by removing the outer hub cap and pulling the cotter pin that attaches the cable to the inner hub. Loosen the nut at the speedometer head and pull the cable from place.

If the cable catches as you pull it from the housing, both the cable and housing are damaged. Replace both.

Checking cable

With the cable out of the housing, check it for a bent tip (speedometer head end), kinks and whipping. If the cable tip is bent replace the cable.

Wipe the cable clean with a rag and lay it out straight on a flat surface. Roll it back and forth. If it doesn't roll smoothly, it is kinked and should be replaced.

Pick the cable up and take an end in each hand. Allow the cable to hang in a 9 to 12-inch loop. Twist it between your fingers. If it whips or jumps rather than turns smoothly, replace the cable.

Cable lubrication

The main reason for speedometer noise is a cable that needs lubrication. Most manufacturers call for lubrication on an as-needed basis—that is, when the cable becomes noisy, lubricate it. In lubricating a speedometer cable, remember that too much grease is as bad as too little. Excess lubricant can cause failure of the speedometer head.

To lubricate a cable, apply a very thin film of speedometer cable lubricant or a lubricant such as Lubriplate that is cold-

resistant and waterproof. Then, wipe off excess by running the entire cable length through your fingers.

Caution: Do not lubricate the cable tip. Grease here will damage the speedometer head.

Checking head

Before putting the cable back into its housing, conduct another easy test to determine if the cause of noise is the drive gear in the speedometer head. Get a short piece of cable, insert it into the head and rotate it. If the head drags or makes noise, that's where the trouble is. Have the head repaired, or replace it.

When reinstalling the cable, feed it through the housing slowly and carefully so you don't kink it. When the cable is just about seated, twist it slightly to engage its far end firmly into the seat in the pinion gear at the transmission.

Of course, with a cable that works off the wheel, make sure that the cable goes through the hole in the hub and that the cotter pin is inserted.

The reasons why a speed indicator will flutter are a kinked cable and housing, which are checked as you pull the cable from the housing, and a damaged speedometer cable. If kinking isn't the problem, replace the cable.

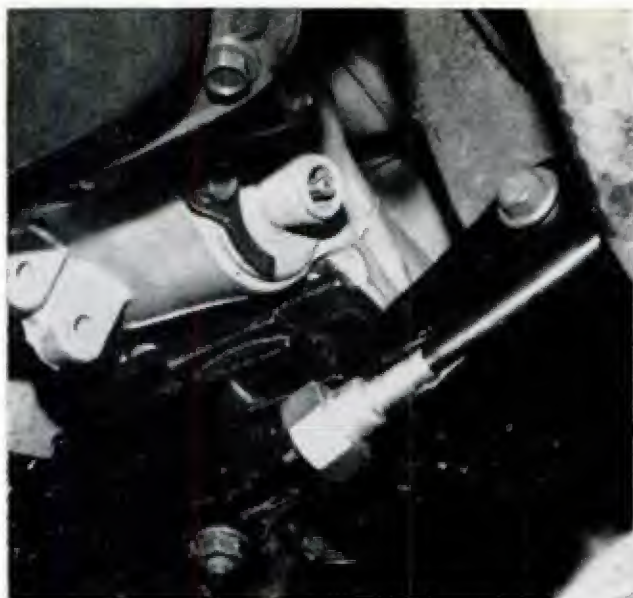
A speedometer that doesn't work at all is the result of a cable that has worked loose from the head (check the coupling) or, more likely, by a cable that has snapped. To get a broken cable out of the housing, you have to disconnect it at the speedometer head and pull one end of it out from there.

Now, get beneath the car and detach the cable housing from the pinion gear. The



GO EASY ON GREASE. Apply a light film to cable and remove excess by running cable through your fingers. Do not get any grease on tip of the cable

POPULAR MECHANICS



WHEN CABLE HOUSING IS LOOSE, pull the broken cable out of the housing and reconnect the housing to the pinion gear. Then install a new cable

other end of the broken cable can now be pulled from the cable housing.

Reconnect the cable housing to the pinion, and install a new speedometer cable from the speedometer head end as explained before.

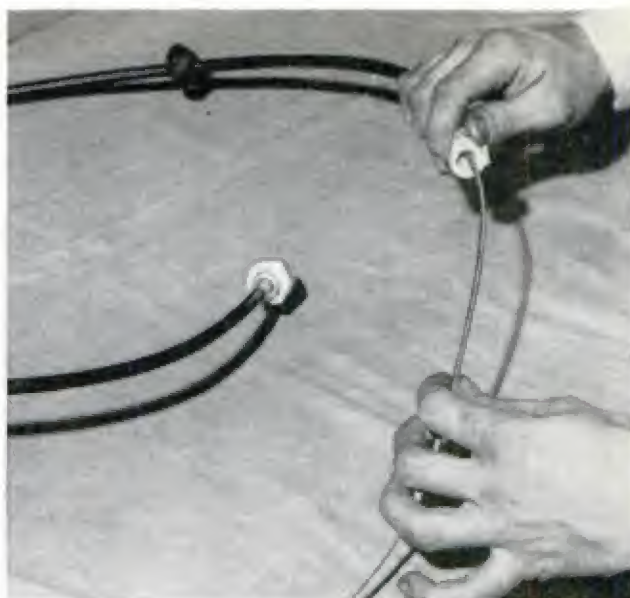
Incidentally, you might wonder why you can't remove any but a broken cable from the transmission end rather than from the speedometer head end. The reason you can't is that knurled stopnut on the tip of the cable. It stops the cable from extending itself too far into the pinion. It will also prevent you from pulling the cable through the tail end of the housing.

If the speedometer needle hangs up, the speedometer head is damaged and has to be repaired or replaced, or the speedometer needle is bent and is rubbing against the dial. Check the needle for rubbing first. If it moves freely after you



TEST SPEEDOMETER HEAD FOR NOISE by inserting a piece of cable into shaft, then rotating it. Movement should be free and there should be no noise

MARCH 1971



THE SPEEDOMETER CABLE fits into the metal funnel of the housing with close tolerance, so feed the cable into the housing slowly to avoid kinking it

straighten it out, there's no need to hire the expensive services of a repairman.

Checking accuracy

How can you tell if your speedometer is accurate? Run distance-time checks or compare with a speedometer on a friend's car that's known to be accurate.

Be sure that both vehicles are moving at a rate of speed that you and the other driver decide on beforehand. You should stay neck and neck. To check the accuracy of the odometer, drive the car over a measured mile. A handy figure to remember is that 60 mph is a mile a minute. You can take further computations from there.

Speedometers will show an incorrect reading if the car is equipped with over-size or under-size tires or if the pinion in the transmission is not the correct one. Rear axle gear ratio and tire size determine pinion gear size.

Consult the speedometer pinion chart provided in the car's service manual. You can buy the correct part from the parts department of a new car dealer who sells your make of car. Installing the pinion is easy enough.

Detach the speedometer cable from the pinion and remove the retainer that holds the pinion in the transmission. Be prepared to catch transmission fluid as you pull the pinion from place.

Now, simply insert the new gear, making sure it engages firmly and fully in the transmission. Reconnect retainer and hook up speedometer cable housing. ★★★

Tripods

Are Up to New Tricks



You wouldn't think they could do much to change the old three-legged camera support, but today's models are loaded with handy improvements that make shooting easier and more fun. Here's the lowdown on features to look for.

By JACKSON HAND

THE ONLY THING that's the same about tripods is that they still have three legs. Gone are the heavy, hard-to-adjust cumbersome supports that used to make you wish you never had to lug one around. The newest models are trim, light and simple to set up. They stand tall, yet fold small for easy carrying. And they have added conveniences such as invertible center posts, tilting arms, flip-top heads and fingertip controls—all designed to make picture taking easier and more fun.

If you haven't been using a tripod, now's the time to consider adding one of these handy accessories to your photo equipment. Professional photographers have a saying they're fond of passing on

to hobbyists—the best picture you ever took would have been better with a tripod. This is true for several reasons. A tripod not only steadies a camera, producing clearer, sharper pictures, but it lets you concentrate on the scene rather than on trying to hold still. You can take your time composing the picture in the viewfinder until you have exactly what you want. Once you've locked the camera in that position, you can forget it. You can make repeated shots at different exposures, knowing that all will show precisely the same view. You can focus sharply without any chance that the camera will move and change the focus before you shoot. For portrait and tabletop photography, a tripod is indispensable since it frees your hands for arranging lights and posing your subject. It also braces a single-lens reflex camera against the jarring shake of its instant-return mirror—a critical problem at slow shutter speeds.

One important feature you'll want to look for in choosing a good tripod is an adjustable center post. This is a column that can be raised and lowered independently of the tripod legs. It's a tremendously useful convenience since it enables you to change the height of the camera without readjusting the length of the legs each time. You just set the legs to the approximate height you'll need, then make fine adjustments using the column. It used to be that only expensive professional tripods came with a center post. Now you can buy an elevator tripod, as it's often called, for as little as \$20.

One problem you have to watch out for with a center column is that it tends to become unsteady if it's extended too far. The higher you go, the farther away you get from the basic rigidity of the tripod legs and the more your camera is likely to wobble. As a good working rule, it's best not to raise the center post more than halfway. If you find you need more height, reset the legs so you can work with the column lowered.

The stiffer the column, the steadier it

YOU CAN SHOOT HIGH OR LOW with invertible tripods like this Quick-Set Husky. Reversible center column allows camera to be suspended below tripod for low-angle shots close to ground (lower right). Group photo at top of opposite page shows a wide variety of tripods from tiny tabletop Vivitar to unusual Spiratone model with tilting center column

MARCH 1971



Three Smart Ways Tripods Use Their Heads



INSTANT-MOUNT FEATURE on Hollywood Futura tripod at left, above, has a cone-shaped fitting that screws into camera. Cone then locks into tripod head with quick flip of lever. At center, calibrated

pan and tilt adjustments on Bilora model permit precise positioning for multiple exposures or panoramic stills. At right, Spiratone's tilt-up head lets you swing camera sideways for vertical shots



will be. Spindly, light-duty tripods may have center posts that are too springy for good support. Some of the better models have added cross braces that run from the legs to a collar around the center post of the tripod.

Cross braces give considerable rigidity, but they also increase the cost and may make the tripod a little less handy to put up and take down. They're good for heavy professional equipment, but probably aren't needed for amateur use.

Many of today's center columns are reversible—another important feature to look for. You can slide the column out at the top, turn it upside down and insert it from underneath the head. This lets you suspend your camera below the tripod for low-angle shots, such as for photographing flowers or insects close to the ground. Your camera is, of course, upside down, but this isn't hard to get used to since the image appears just as it would if the camera were upright anyway.

If you're likely to be doing a lot of low-angle shooting, be sure the column is invertible—not all are. If you should have a noninvertible model, you can achieve somewhat the same effect by using a special accessory bracket that clamps to the lower end of the center post to hold the camera down low. There are also brackets that clamp onto a leg to lower



TWO RECENT DEVELOPMENTS in tripods are Spiratone's tilting-column model at upper left and palm-size miniatures like the Vivitar shorty at lower left. The tilting column is handy for high-angle shots or overhead copy work. Shorty tripods are excellent for tabletop use, can extend to four feet

Three New Quick and Easy Leg Adjustments



SPEEDY LEG ADJUSTMENTS are found on many new tripods, such as Quick-Set's automatic cam at left, above. You just pull out leg to desired length and it locks by itself. Pressing lever releases cam to

shorten leg. At center is Safe-Lok's lever arrangement at top of each leg. A half turn locks and releases legs. At right is Spiratone's quick-acting finger catch—press in to lock, flip out to release

the camera on tripods having no center columns.

One particularly ingenious new idea in tripod design is Spiratone's tilting center column that swings from vertical to horizontal. This lets you get your camera up and over your subject for straight-down shooting or copying. In the horizontal position, the column can be used like a sliding rail to move the camera forward or back for critical close-up work. Price is about \$23. Somewhat similar rails are available as accessories for regular fixed-column tripods.

One of the biggest improvements in new tripods is the square tube or channel leg with a quick lock-release arrangement for fast setting up. Instead of having to turn a threaded collet, you just flip a finger catch to extend or shorten each leg section. One clever variation is Quick-Set's automatic cam lock. To extend a leg, you slide it out to the desired length and it locks there by itself. The finger latch is pressed only when you want to release the leg to shorten it. Another easy-adjust system is Safe-Lok's lever arrangement at the top of the legs. You simply reach down under the head and flick the lever to lock or release each leg.

Getting a camera onto a tripod has always been a time-consuming nuisance
(Please turn to page 186)

HANDY ACCESSORIES for any tripod are ball-and-socket swivel (near right), sliding extension arm for vertical or horizontal mounting (center) and hinged tilt-up attachment for flipping camera to sideways position (far right). Swivel and tilt-up bracket are by Hollywood, extension arm by Bilora

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JUST PRESS A BUTTON and this motorized panning attachment swings a movie camera in a slow arc for smooth panorama shots. Powered by batteries, it fits any tripod head, is sold by Bilora for \$49.50



MAKE A GRAND ENTRY

If the foyer in your home looks a little drab, you can perk it up easily and inexpensively by remodeling the door and adding a filigree-paneled archway

By ROSARIO CAPOTOSTO

ARCHITECTURAL STYLES have been changing dramatically since the post-World War II building boom, but there's one design feature that's found in nearly every home built in the last two decades. It's the lackluster front-door foyer. Fortunately, it doesn't take much effort, imagination or money to brighten up a drab entryway.

Starting with the conventional front door shown at right, we ended up with a bright, cheerful entry (see facing page) that really does *welcome* people to our house.

The job can be tackled in two stages, if you desire. But, to assure continuity of design, lay out the *total* project at one time. If you don't, you may be tempted to change style slightly when you start the second stage. The result then is almost certain to show that you changed your mind in mid-project.

Once we settled on our overall design, material selection was a snap. Translucent panels in the door and arch and the filigree are manufactured by Masonite Corp., 29 N. Wacker Drive, Chicago, Ill. 60606. Walls in the foyer were skinned with Tuscan Travertine planks made by Marlite Paneling, Dover, Ohio. All products used in the project are available at well-stocked lumberyards.

● *Customizing the door.* To start, knock out the hinge pins and set the door on sawhorses. Clamp or tack-nail a straightedge to guide your saw and make the four cuts to drop out the opening. A sabre saw will cut right up to a corner; with a portable circular saw, you'll have to stop



ORIGINAL FOYER was drab, uninteresting. Updated door, arch, Marlite Travertine on walls changed it



INTERNAL CUT required plunge cut with sabre or circular saw. Use straightedge for the neatest cut



A FRONT ENTRANCE takes on an elegant look with a minimum cash outlay when you tackle the project yourself. The door is adapted from the original; the divider is built of stock items



PANEL ADHESIVE simplifies facing the door interior with flush panel. Apply a thin, flat coat to door

short of each corner and finish them with a handsaw. If you decide (as I did) to panel the door's interior, let the saw blade project as much as possible and cut with the inside of the door facing upward. Paneling will hide the extended corner kerfs. Finish the preparation by scraping off any loose paint.

Apply a piece of $\frac{1}{8}$ -in. luan plywood (or your own choice of paneling) with an insert opening 1 in. smaller overall to the door with panel adhesive. Do as the pros

PRECISE ANGLE required for each diagonal piece is determined by positioning before cutting mating dado



ROUTER AND SHAPED CUTTER dress up strips. Make sure that parts are numbered before disassembling



POSITION PANEL and drive a few brads to prevent it from shifting. Use weights until the glue is dry

do and drive a few small brads at random to prevent the panel from sliding. Use clamps or ample weight to make good contact overall. But, do not use excessive pressure with the clamps.

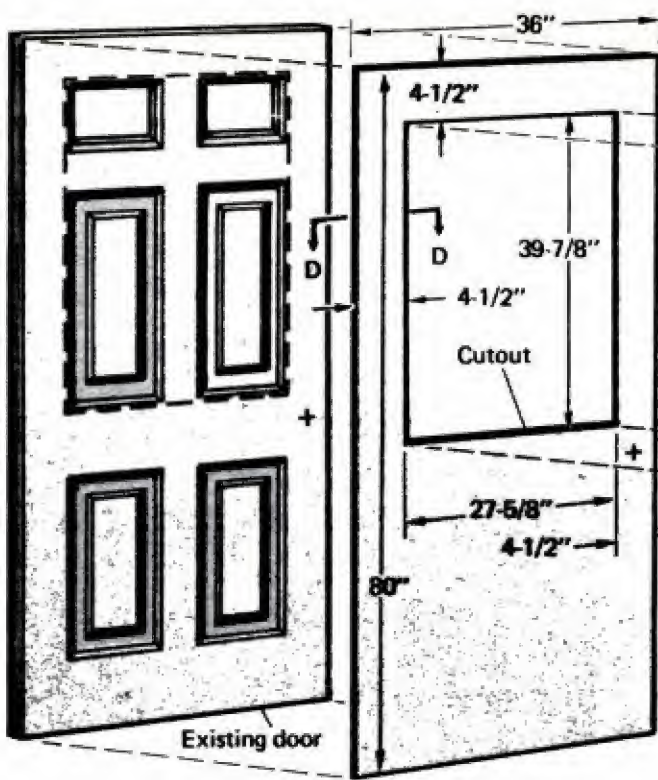
The insert plastic-panel framing is made of solid mahogany to match the new interior panel of the door. Make a rectangular frame, butt-jointed and dimensioned to fit snugly into the door opening. Cut the rabbet in the frame members before gluing and screwing them together. Exact

COMBINATION SAW BLADE can be used for dados by making series of cuts. Shift work with each pass

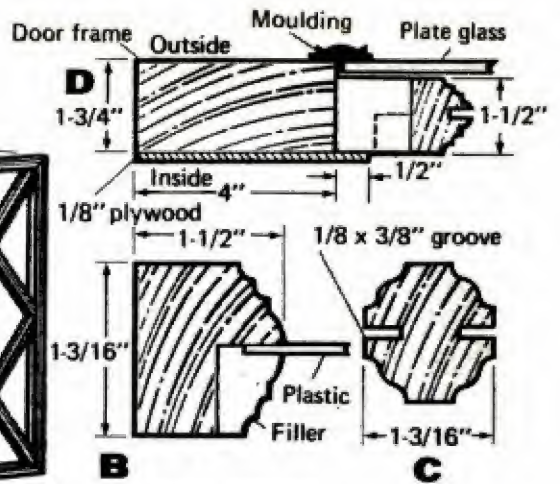
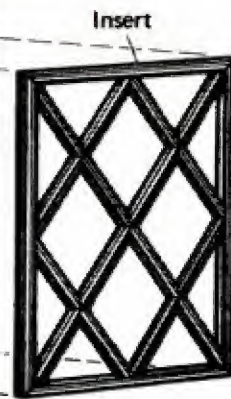


PLASTIC INSERTS are labeled for reassembly identity. GE Silicone Seal keeps the pieces from shifting

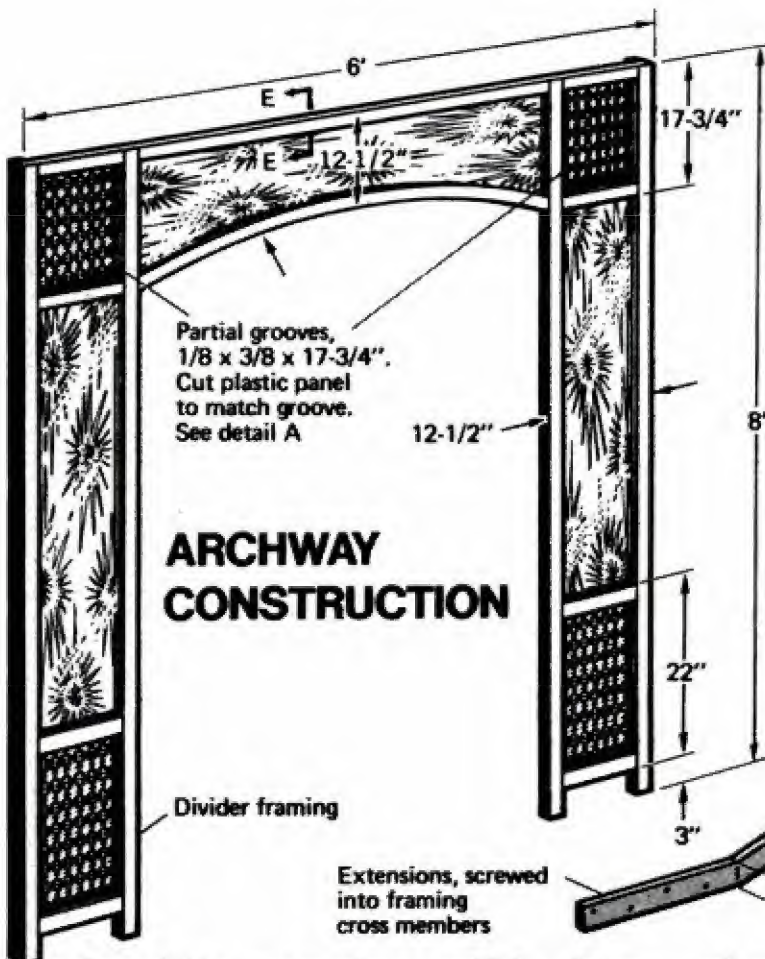
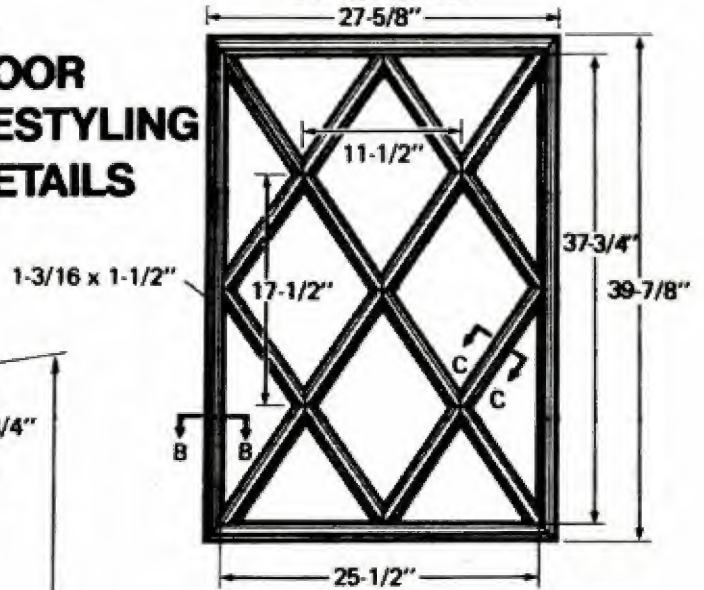




DOOR RESTYLING DETAILS

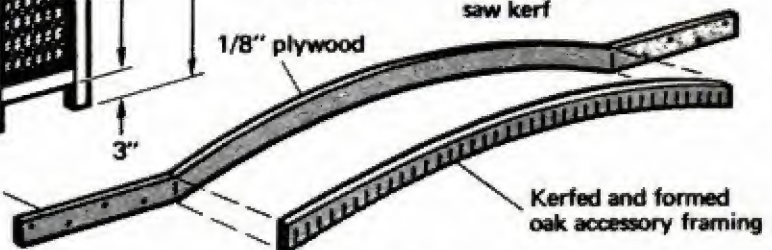
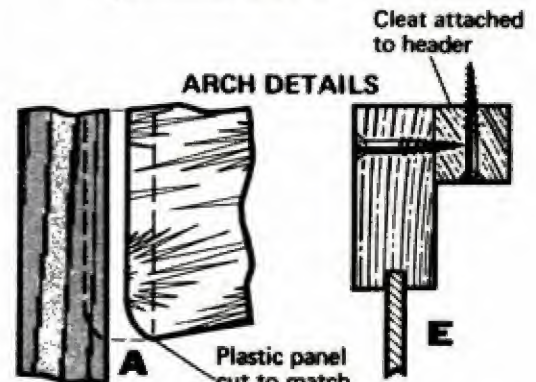


DOOR INSERT



ARCHWAY CONSTRUCTION

ARCH DETAILS



angles of the cross pieces will be determined by the size of your door opening (this varies with different doors). Inasmuch as the plastic panel inserts used are designed for interior use only, we inserted plate glass over the entire insert panel on the exterior. Thus, you must allow for the thickness of the glass (or plexiglass)

when figuring the depth of the insert frame lumber.

The easiest way to lay out the crisscross members is to begin with an X from corner to corner. Draw the angles indicated at the center and the corners and cut them. The center gets a crosslap; the ends

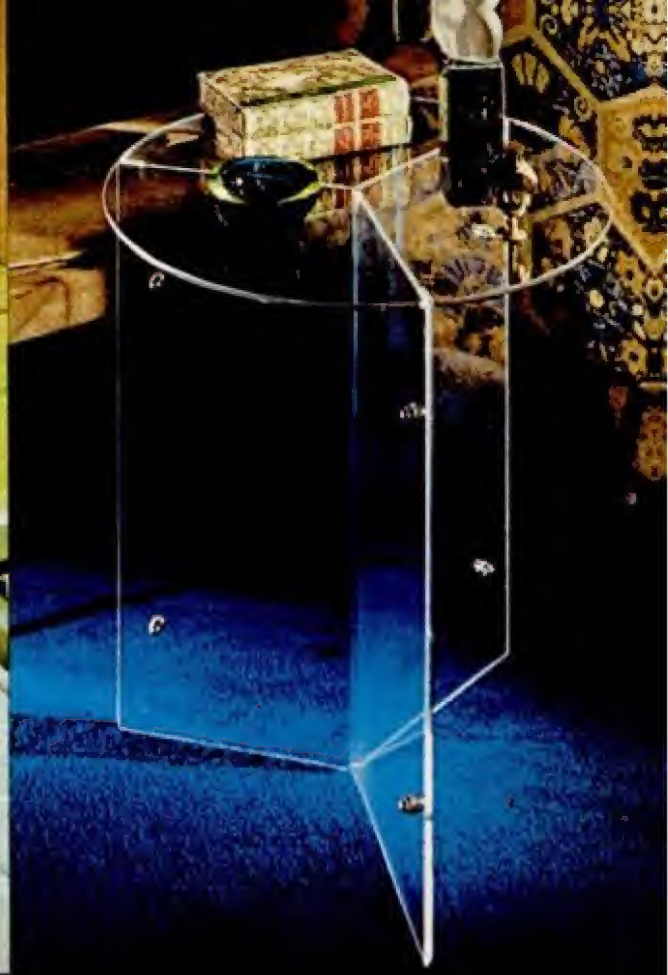
(Please turn to page 178)

The Light, Lustrous Look of Glass—and You Can Make Them

By WAYNE C. LECKEY
Home and Shop Editor



SHEETS of amber Plexiglas were used to make this handsome see-through coffee table. The material is available in translucent and opaque colors as well as clear.

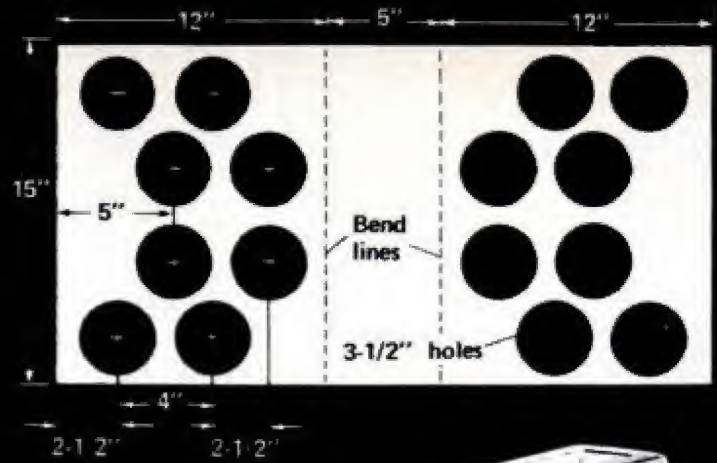
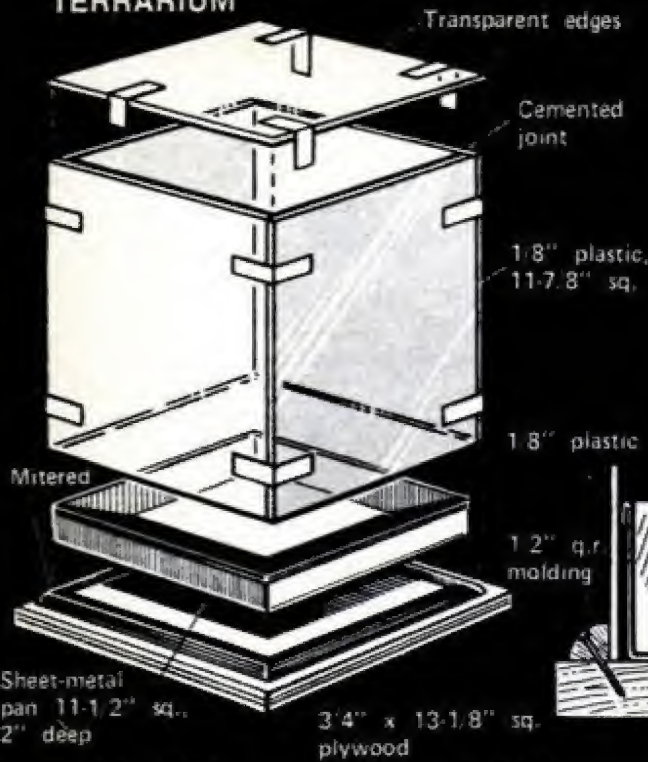


PERHAPS NO OTHER CRAFT MATERIAL can compare with the "factory-made" look you get when a project is made from glass-like sheets of plastic—the finished piece is just too professional looking for one to think it could be made at home. Yet acrylic sheet plastic is as easy to work with as any home workshop material—it can be sawed, drilled and cemented almost as easily as wood. What's more, it even can be heat-formed into interesting shapes, something you can't do readily with wood. You'll find it a fascinating material on your very first try.

The projects shown here were made of Plexiglas, a material that's tougher than



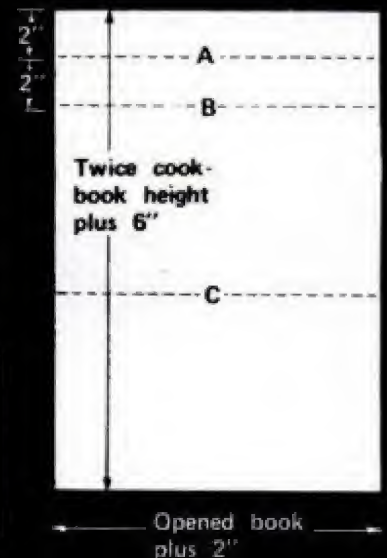
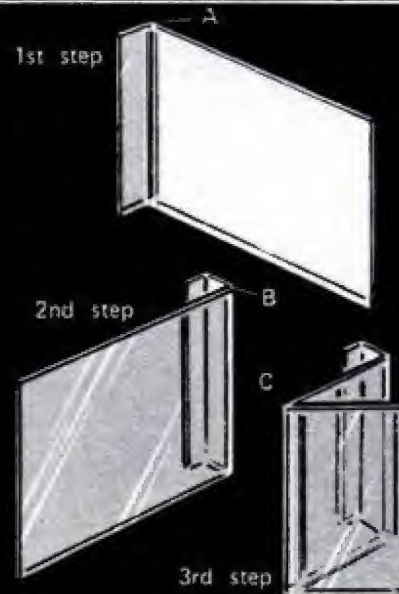
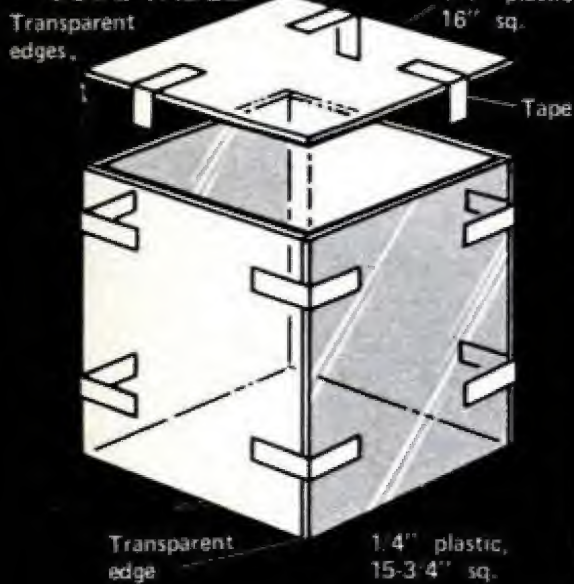
TERRARIUM



WINE RACK



CUBE TABLE



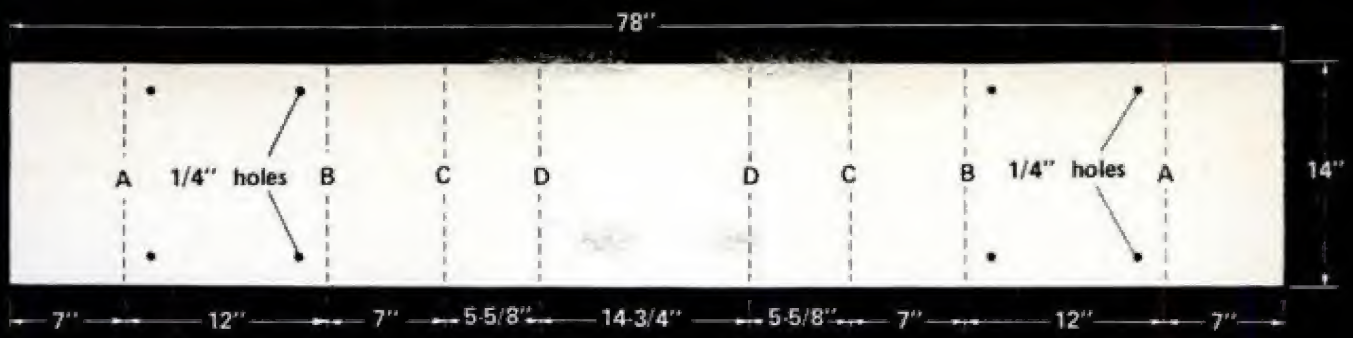
COOKBOOK HOLDER

glass, and is a product of the Rohm and Haas Co. The examples represent but a few of the dozens of things that the imaginative home craftsman can create from translucent, opaque and transparent sheets.

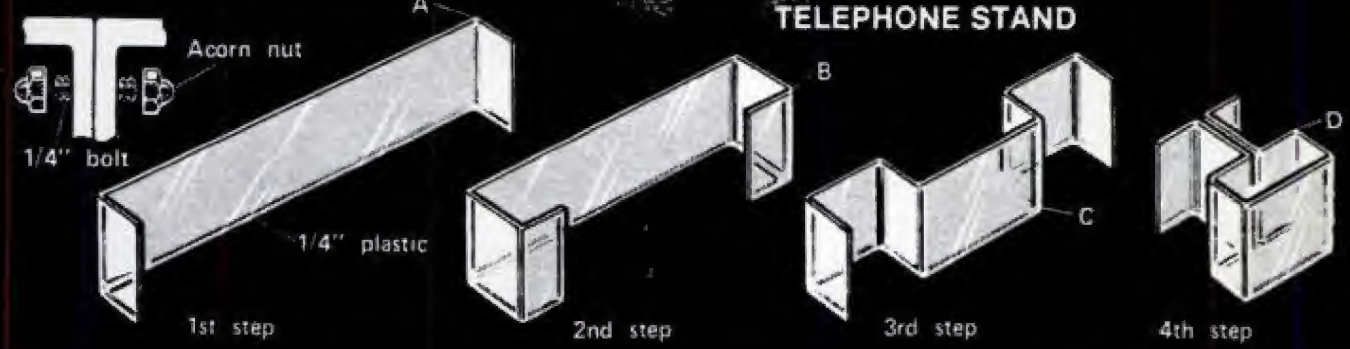
Basic fabricating steps for working with acrylic sheet plastic were presented in a previous article (see *How to Work With Plexiglas*, page 176, June '70 PM) which showed how you cut, drill, polish, cement and bend the material.

Three of the projects, the wine rack, cookbook holder and telephone stand, are formed from one piece of plastic by heat-forming. Of the three the telephone stand is the trickiest to make. Each pair of bends must be made alike in the sequence given, otherwise you will wind up with a somewhat cockeyed form. Use a grease pencil to mark the plastic where it is to be bent and center the pencil mark over the heater element. It will take from 8 to 10 min. to heat 1/8-in.-thick plastic to a bendable state. Make the bend slowly, on the line, while the plastic is still on the heater. You'll find that the plastic has a tendency to "spring" back as it cools, so you must compensate a bit when forming a right-angle bend. In the case of the telephone stand

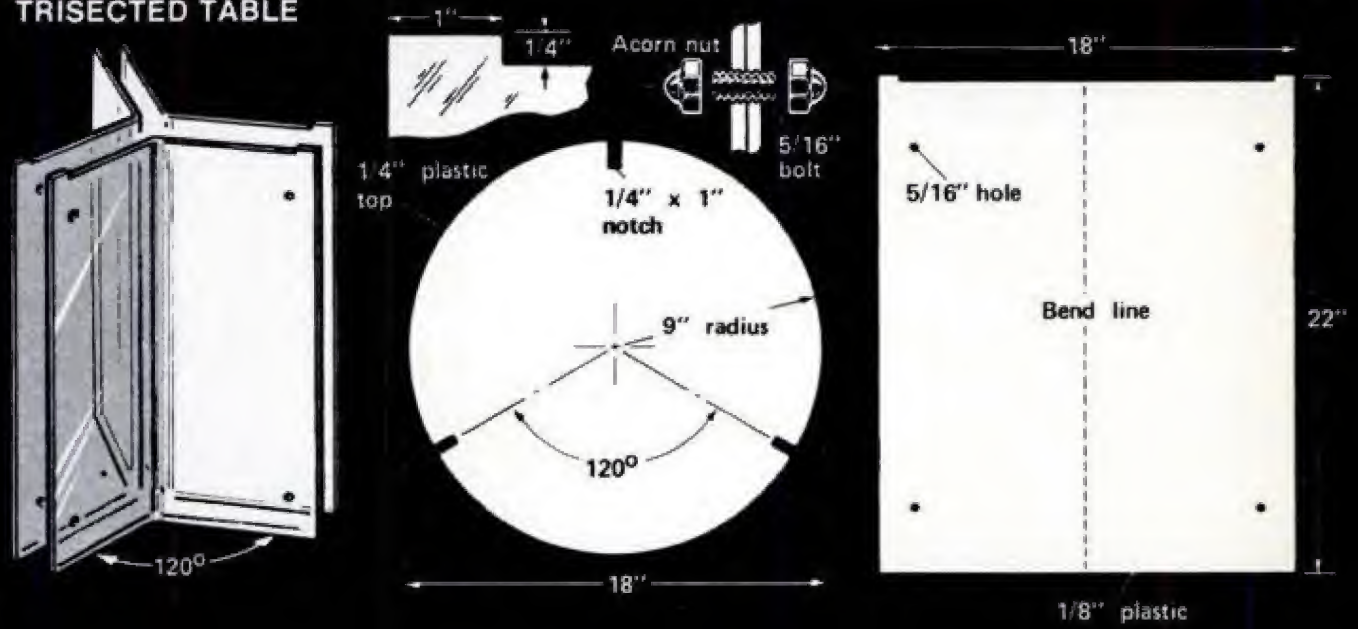
Please turn to page 184.



TELEPHONE STAND



TRISECTED TABLE



TO BEND PLASTIC, protective paper is removed and plastic is placed over heat tape in homemade heater

"NEEDLE" SPOUT makes special solvent applicator dripless, lets you apply watery cement to seam only





You Can Build This Early American Gossip Bench

Charming colonial piece in warm cinnamon finish provides a convenient place to sit and chat

By WAYNE C. LECKEY, Home and Shop Editor

IF YOU LIKE FURNITURE with a past, you'll like this authentic Early American gossip bench. Crafted in solid cherry in our own cabinet shop, this handsome piece is something you'll cherish for years to come. It has a shelf for the phone and a place below for directories.

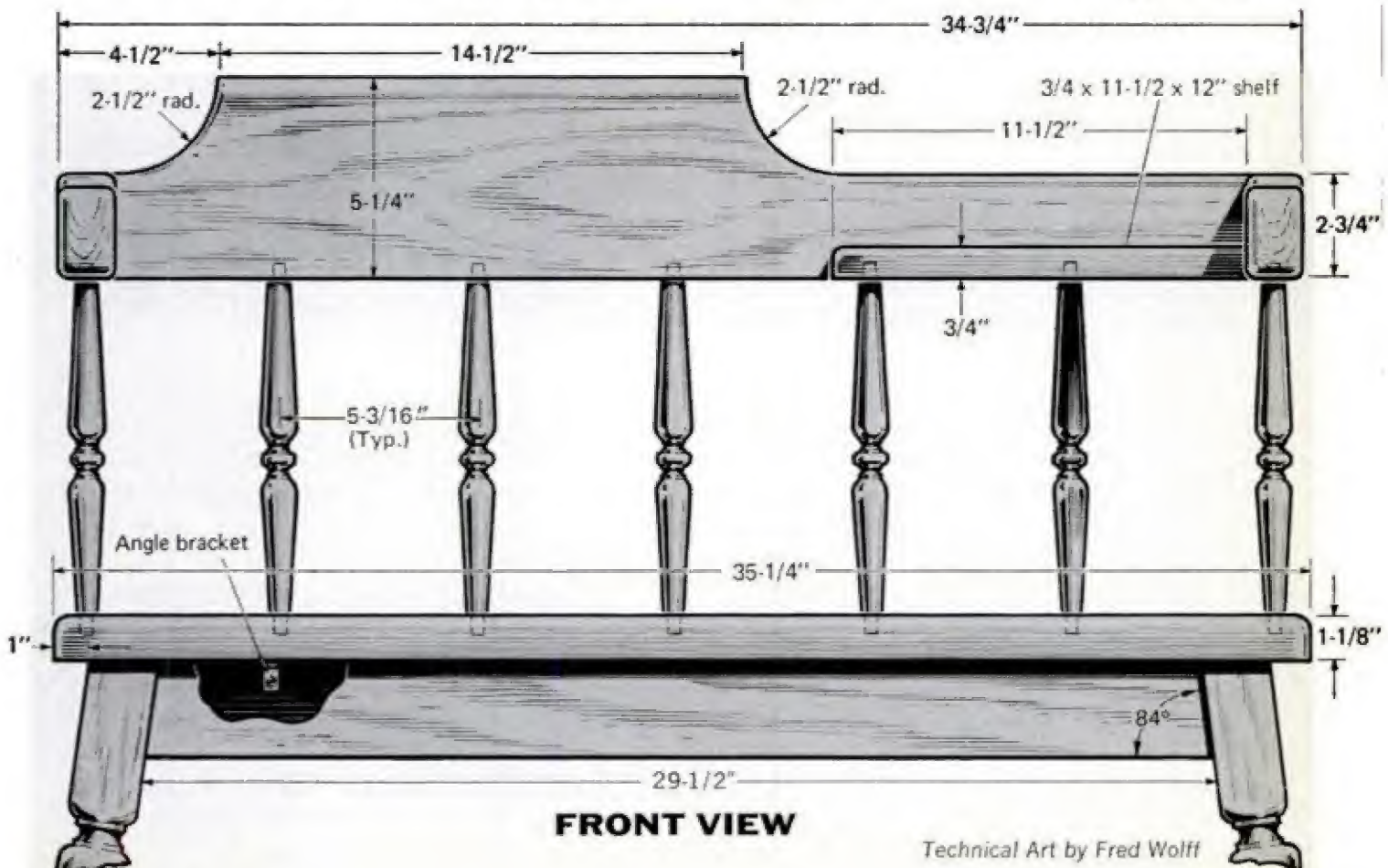
To make it you'll need a wood lathe to turn the 4 legs and 13 spindles. The legs are turned from 1 $\frac{3}{4}$ -in. turning squares, 16 in. long. When mounting the blanks between centers, place the unturned end of the leg at the headstock end of the lathe. Turn the first leg by following the pattern

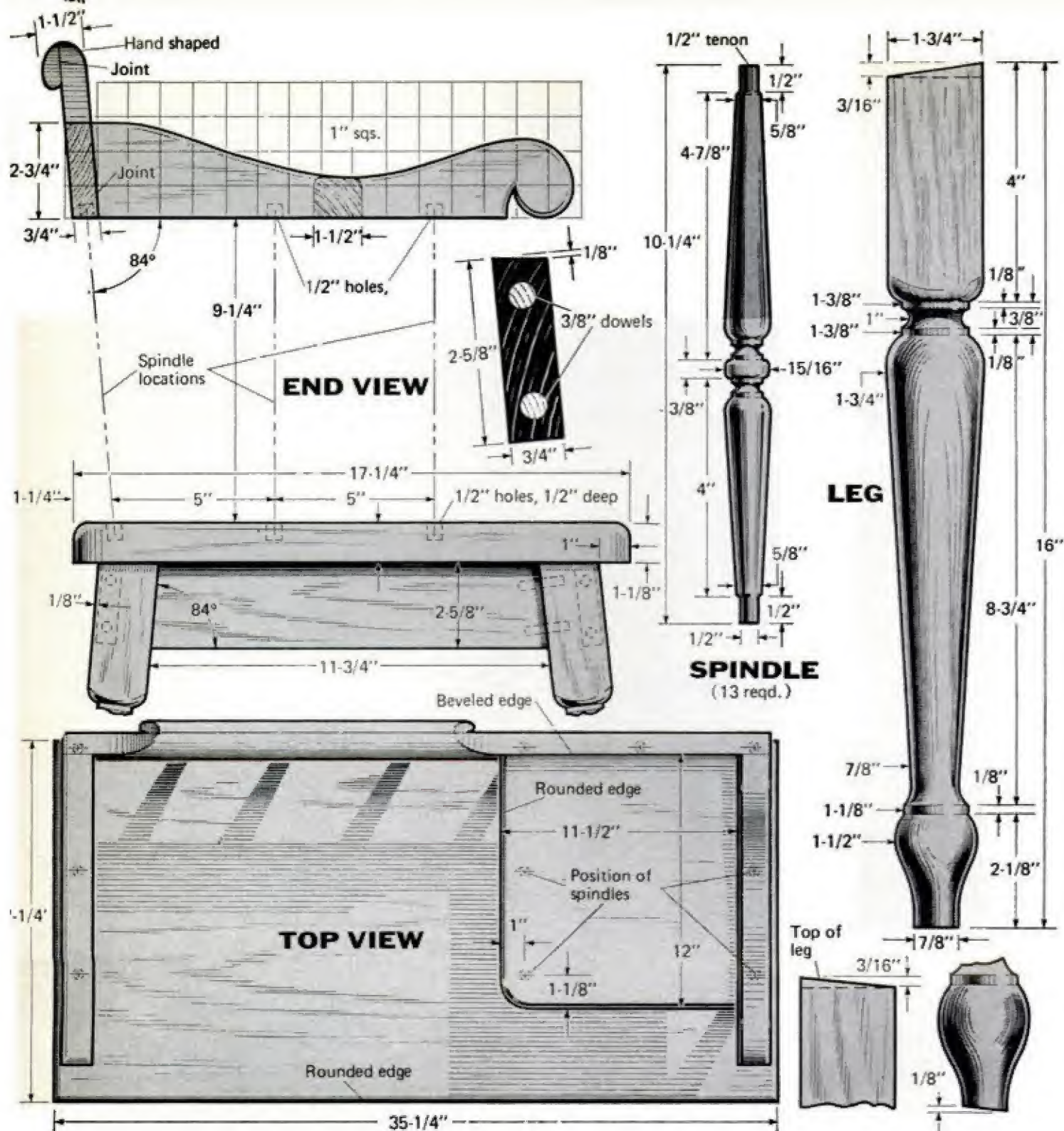
Color Photo by Bill Maris/Styling by Bob Lofgren

given, then use it as a sample in turning the others. Notice that the tops of the legs require a compound cut to provide the proper leg splay. This is done by tilting both the blade and the miter gauge on your table saw. A similar bevel is made at the opposite end of each leg but this is done after the base is completed.

Each of the 13 spindles is turned from 1-in.-sq. stock, approximately 12 in. long. Finish-sand each spindle while in the lathe and turn a $\frac{1}{2}$ -in. tenon at each end. Use the first turning as a sample for the others.

The $\frac{3}{4}$ -in. seat aprons are ripped 2 $\frac{5}{8}$





in. wide. Notice that the top edges are beveled and that the ends are cut at an 84° angle. The end aprons are 11 3/4 in. long, the side rails 29 1/2 in.

The aprons are attached to the legs with 3/8-in. dowels and are set in 1/8 in. Assemble the legs and end aprons in pairs, then add the side aprons. Check for squareness and hold it squarely with a temporary cross brace.

The seat is 1 1/8-in. solid cherry. If you wish, you can simulate this thickness by adding 1/4 x 1 1/8-in. strips to the edges of a 16 3/4 x 34 3/4-in. panel of veneer-face, lumber-core plywood and mitering the

corners. Use your router to round the top edges of the seat, then lay out and bore the 1/2-in. holes for the 13 spindles. Notice that all are bored at a 90° angle except those along the back. Here the holes are bored at an 84° angle.

Next, cut out the back rail according to the dimensions given in the front and end views. You'll notice that the decorative "curl" along the top of the rail is hand-shaped after you double the thickness with a second 3/4-in. strip.

Seven 1/2-in. spindle holes are required in the back rail. These are aligned with

(Please turn to page 198)

HINTS FROM READERS

King-size kite reel

After observing the frustration my youngster endured whenever she attempted to rewind the kite string on the cardboard core it originally came on I made this reel, which works like a charm. I used a 3-in. paint roller for a handle and made the spool from $\frac{1}{4}$ -in. plywood and a short piece of an old tailpipe, although tubing would do.

Simply cut the plywood to the diameter shown and, using a holesaw, cut grooves to receive the tailpipe. Use three $\frac{1}{4}$ -in. bolts through the center of the reel to hold the three components together. (Two would probably do the job but, built as shown, my version has taken all kinds of abuse without weakening.) As can be seen in the sketch, the handle for winding consists of a thread spool and a short bolt that fits its center hole. Though not a must, I sealed the plywood edges and then gave the reel a couple of coats of paint.

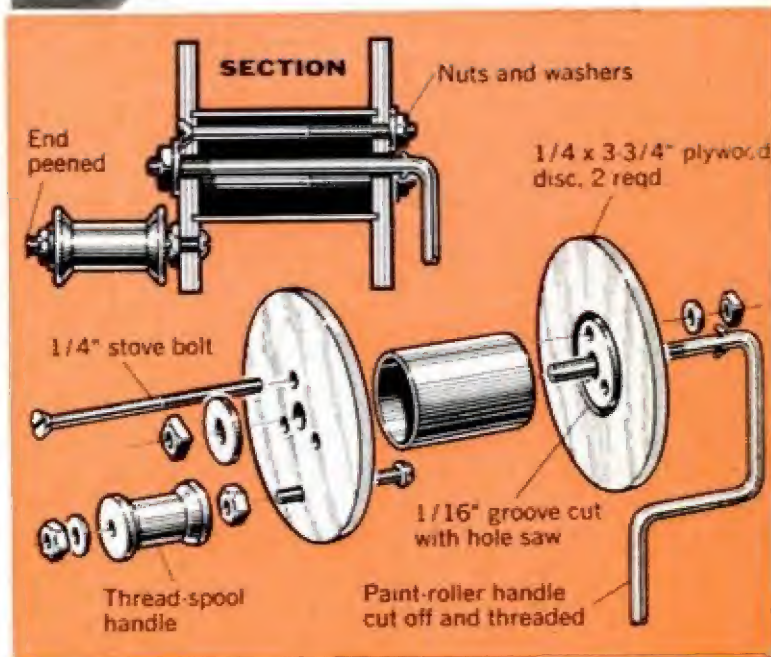
—Taylor M. Boyer



Quick way to solder aluminum

Often when soldering to—or on—aluminum, the task is difficult even though you may be using a special aluminum solder and flux. An easy way is to take a strip of aluminum solder and a piece of aluminum-core solder and hold the two together. Then, using an electric iron or gun of at least 135 w., apply the two solders simultaneously. You'll find they will fuse together at a low melting point, but make certain that the aluminum being soldered is hot enough to assure a good bond.

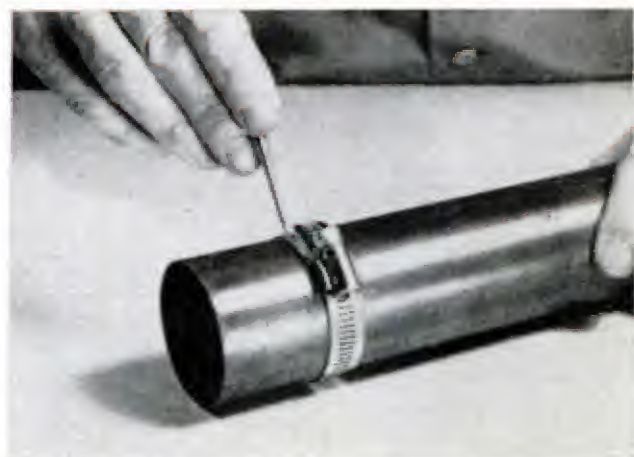
—H. Miller



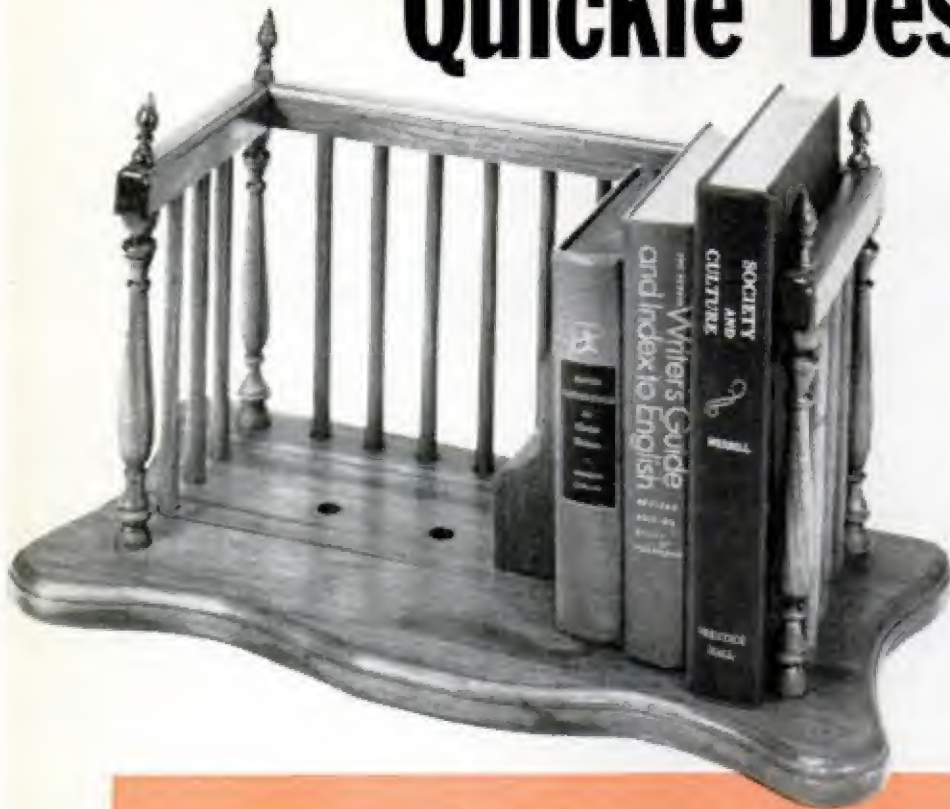
Hose clamp guides layout

A hose clamp installed around a tube or shaft can serve as a guide in scribing a line or spotting hole positions accurately. If you use a gear-type clamp, you'll find that it will have reasonably straight edges and can be adjusted for a true circumference. Thus, you'll obtain a line around the circumference that coincides with a plane perpendicular to the tube or shaft axis.

—B. W. Ervin



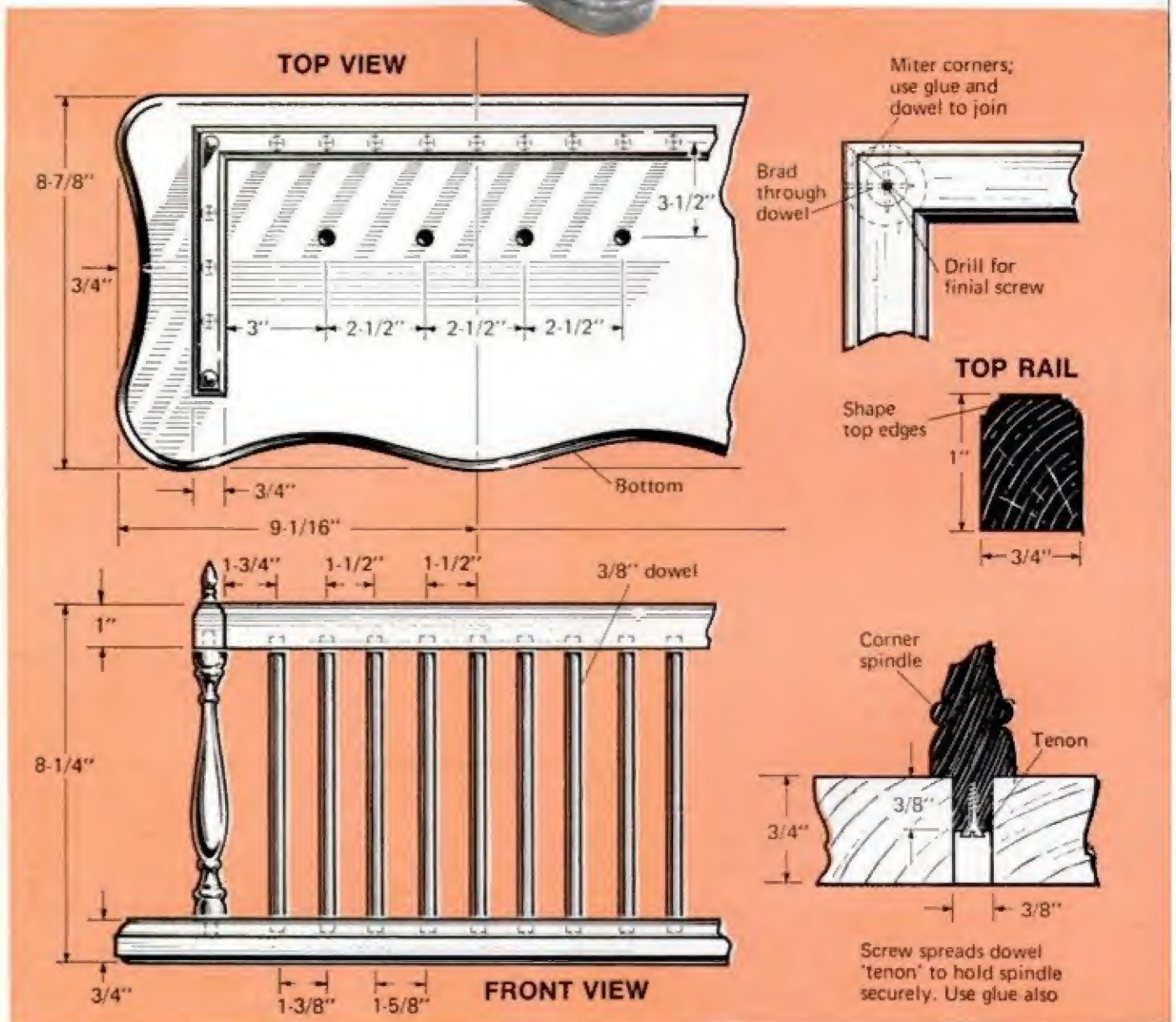
Quickie Designs That



Colonial Bookrack

A handsome but seldom seen piece these days is the small bookrack that was built to be set upon a chest or other piece of furniture. My version is a replica of those that were found in almost every American home a century or so ago.

Except for the spindles and dowels, the entire piece can be made of pine. However, if you prefer, the rack can be cut from hardwood,

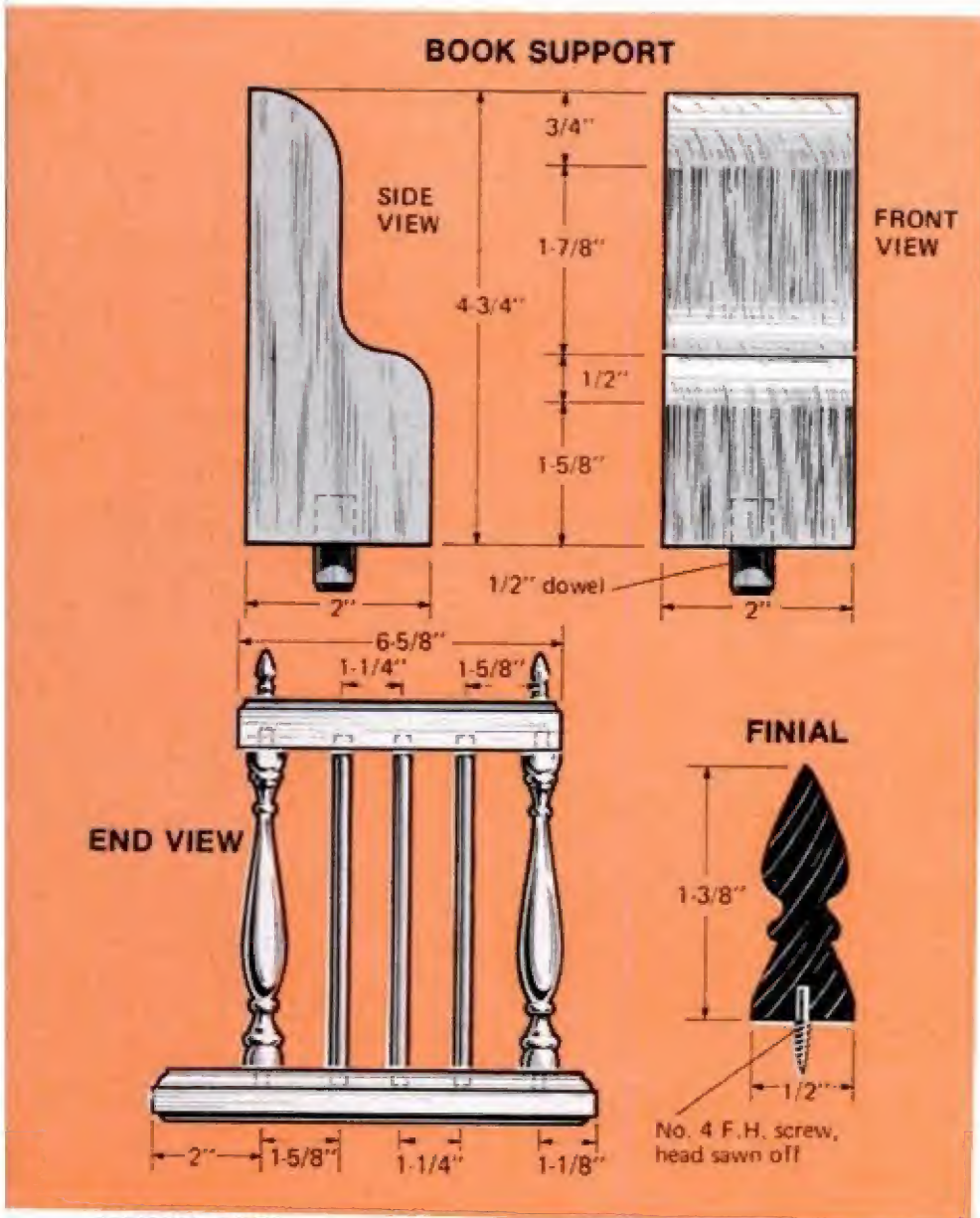
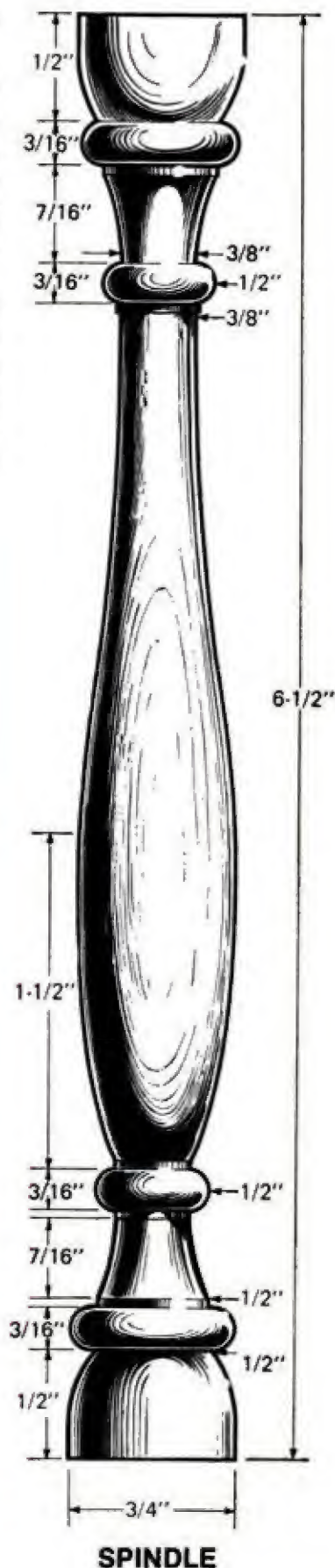


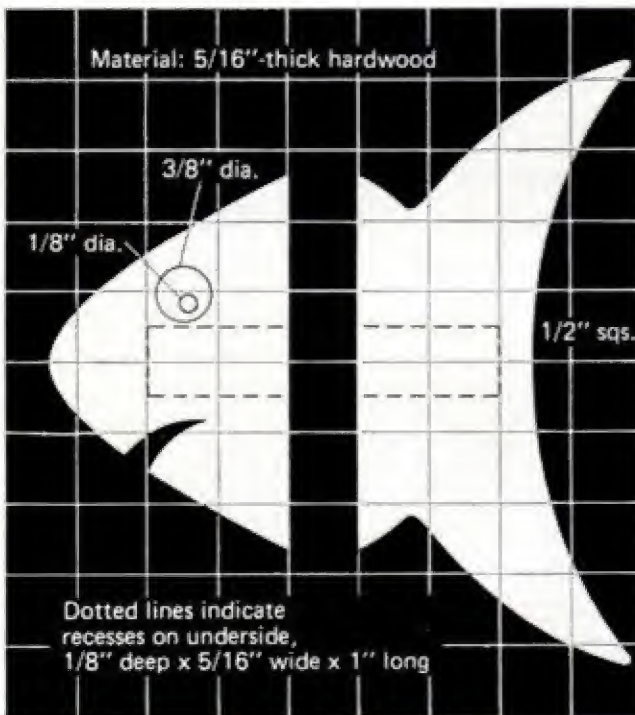
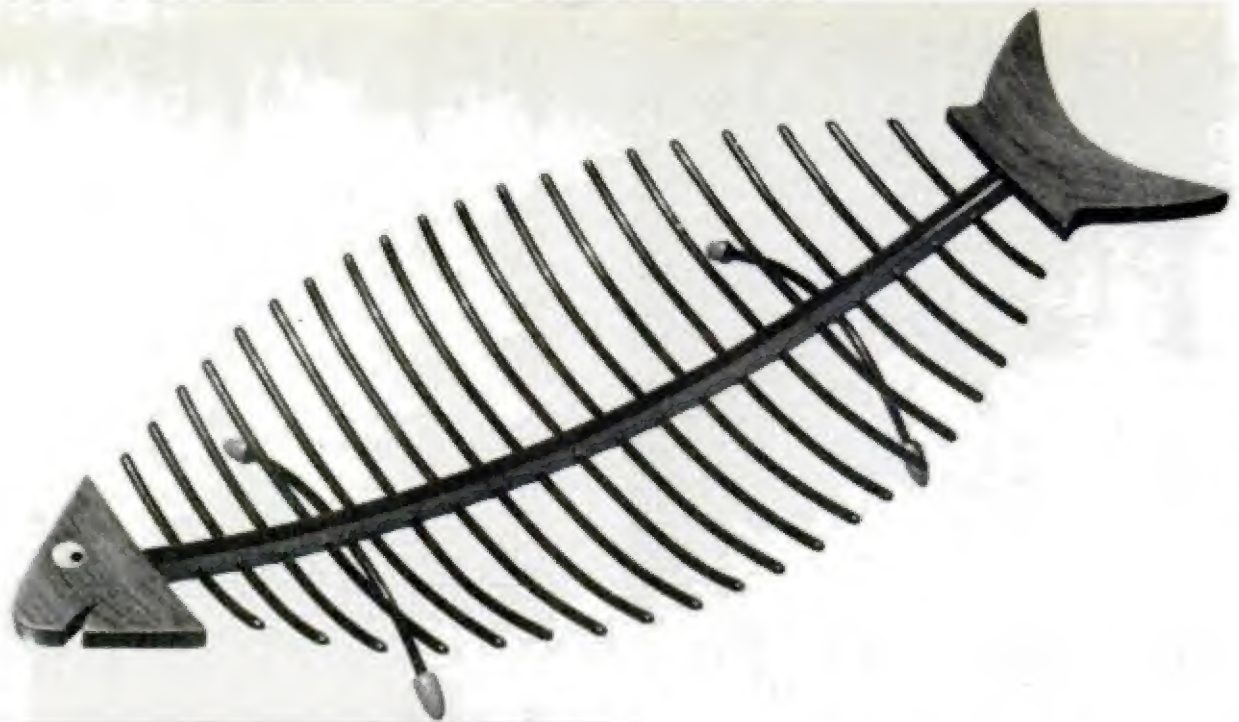
Keep the Sawdust Flying

such as walnut or cherry which have particularly attractive grain patterns.

Start by making a full-size pattern of the base and, after cutting and shaping, lay out the dowel and spindle locations. The dowels can be turned on your lathe, but if you prefer, the commercial hardwood dowels that are available at lumberyards will do the trick; if you use the latter you'll just have to spend a little more time staining to insure a good overall match.

Assembling the rack calls for a little planning ahead. The nature of the project requires that a number of pieces be assembled simultaneously. First, assemble the top rails as one unit. Then, saw kerfs in the lower ends of the dowels and assemble the dowels and corner spindles to the base and top rail. A small screw driven up into each kerfed dowel wedges them securely.—Richard Sickler

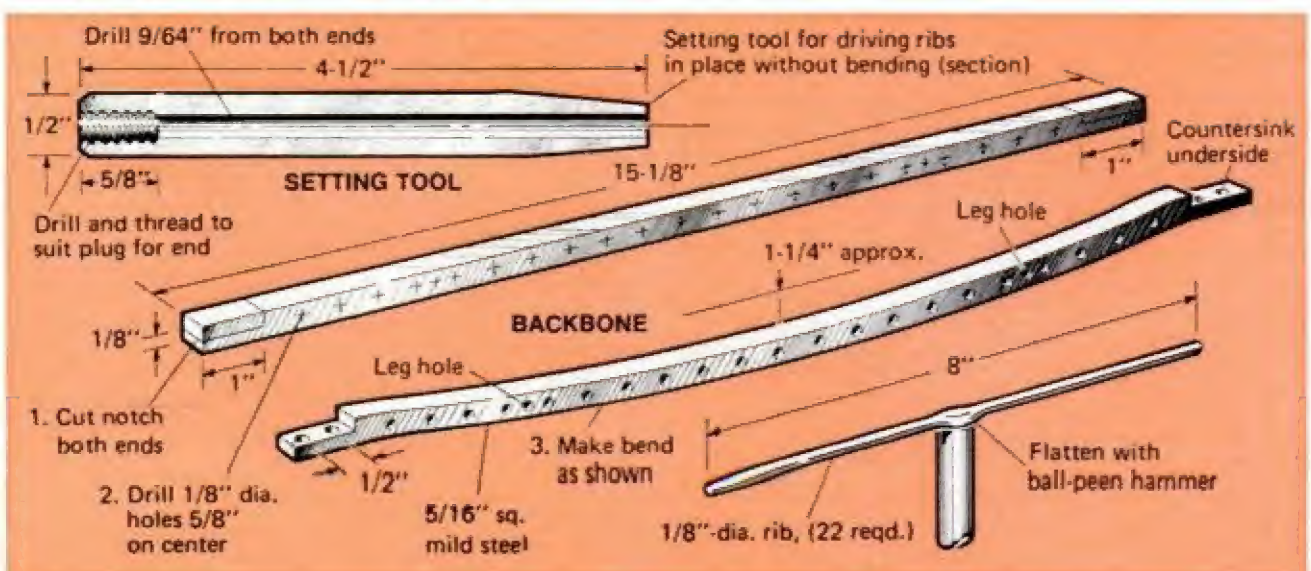


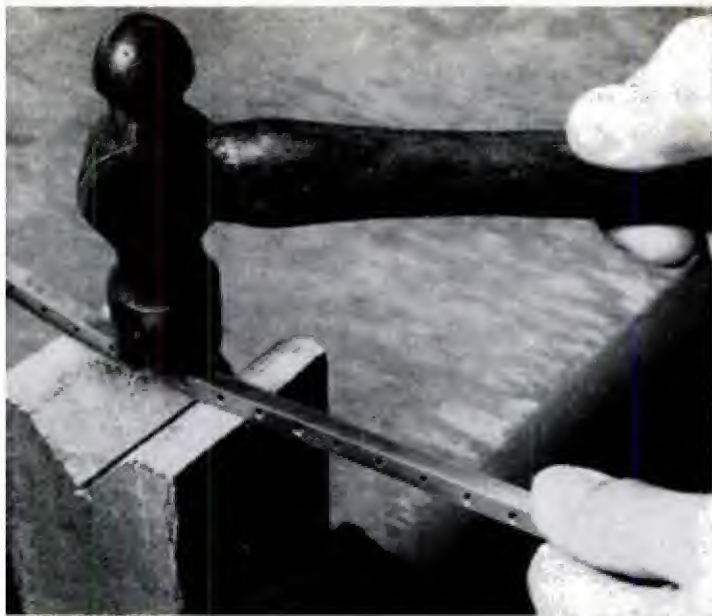


Novel Hors d'Oeuvre Server

Using just a few basic tools and a drill press, you can whip out this skeleton-like "fish dish" in one Saturday work session. To simplify construction, the "ribs" are fixed into the "backbone" without soldering. Use 5/16-in.-sq. mild steel bar for the backbone and, after cutting it to length, saw and file the ends for the head and tail. Mark off and drill the holes on the backbone, deburring all except the head and tail-fixing holes which should be countersunk on the underside. To assemble, it is necessary to use a "setting tool" as shown. Since all ribs are originally cut the same length, after assembly, mark the desired fish shape using a felt tip pen and cut the individual ribs to the desired lengths.

—Kenneth Wells

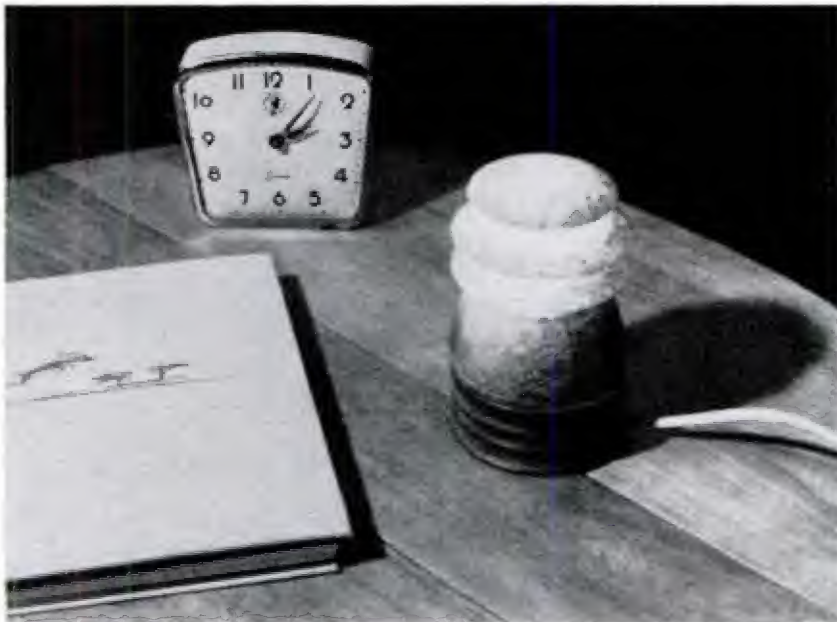




BACKBONE CURVATURE is achieved by placing rod over notch cut in a 4x4 and tapping it with hammer



RIBS are driven with special setting tool. After all ribs are in place, cut them to the shape of a fish



TELEPHONE LINE-INSULATOR makes handsome night light, can be quickly changed if you want another color



Ornamental Night Light

While I am not a dedicated collector of old telephone-line insulators, the assortment that I've gathered over a period of years has stirred considerable comment from just about every visitor to our home. Blue is the most common color and these sell for about a dollar or so in antique and junk shops. Even the most easily obtainable clear ones can be made attractive by heating in an oven and then dipping them in cold water (this gives a crackle effect). To make the light, first turn a suitable base. Attach a candelabra-size socket to the base and run the cord down through a centerhole and out the side. Attach a line plug and switch to complete the job; the insulator simply rests in place and is not fastened.

—C. Wayne Close



INSULATORS are available in a large variety of interesting shapes and colors. Author found that swap and junk shops are usually the best sources

EXCITING NEW PRODUCTS

BY CATHERINE BILSKI



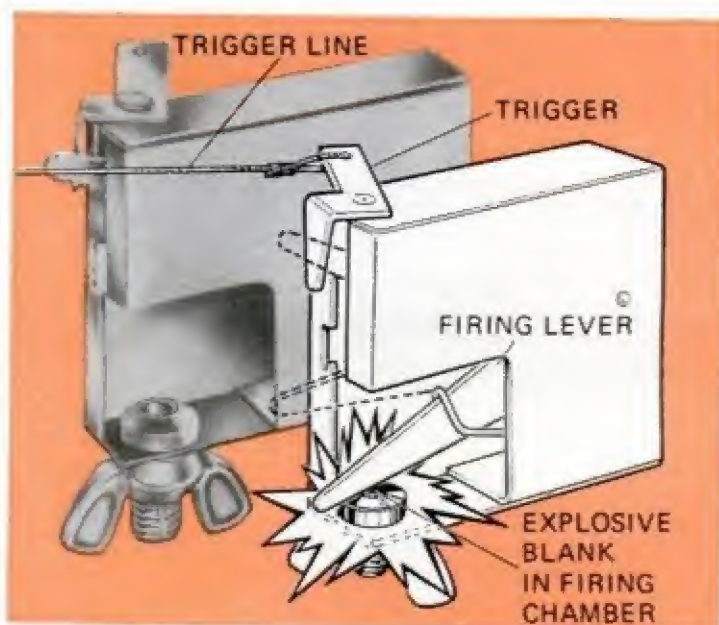
IS YOUR LADDER causing scrapes and scratches on exterior or interior surfaces? If it is, Eazy Ladder Protectors will solve the problem. Made of durable foam plastic, they slip on or off in seconds and when not on a ladder, they can be used as hand sponges for cleaning walls, car and woodwork. Price is \$1.98 a pair from Rochester Eazy Products, 272 Spencer St., Rochester, N.Y. 14608.



ADD EXCITEMENT to a foot of space or accent an entire wall with these carefully constructed and masterfully finished shelves. They're made of solid native oak, deep stained and finished as fine furniture. They're available in a variety of shelf widths and lengths, as well as in special units for stereo, television and magazines. Made by Kirsch Co., Sturgis, Mich. 49091.



AT NIGHT, disabled cars are often hard for other drivers to see. So be safe—be seen with the Blinki-Lux Warning Signal. Its flashing light switches on automatically at the approach of another vehicle and keeps on flashing until it has passed. \$11.95 from the E. J. Co., Dept. PM-30, 704 S. Fifth Ave., Mount Vernon, N.Y. 10550.



SCARE OFF PROWLERS and burglars with the Snooper-Stopper warning signal. Its positive trigger and spring-action mechanism fires a 22-cal. explosive blank when the firing lever is tripped, producing a loud, "gunshot-like" sound. Heavily plated so it will not rust or corrode in any weather condition, the signal sells for \$5.98 postpaid from Harris International Enterprises, Box 11, Kooskia, Idaho 83539.



WHEREVER YOU'RE GOING—camping, on a picnic, to the beach or sitting out on the patio—take the Porta Lamp along. It's cordless, battery-operated and safe: no fumes, fuel or flames. The shade, base and jacket are molded of polyethylene, making it strong and durable. It sells for \$9.95 (with battery) from the Hipwell Manufacturing Co., 831 West North Ave., Pittsburgh, Pa. 15233.



BE AHEAD OF THE TIMES in keeping the time with General Electric's Chronosan ED-3 digital read-out timepiece. It has no hands or dial face, no motors or moving parts, no tick-tock or motor sounds and no clanging or buzzing alarms and it complements any decor. Suggested retail price is \$250 from General Electric, Housewares Div., 1285 Boston Ave., Bridgeport, Conn. 06602.



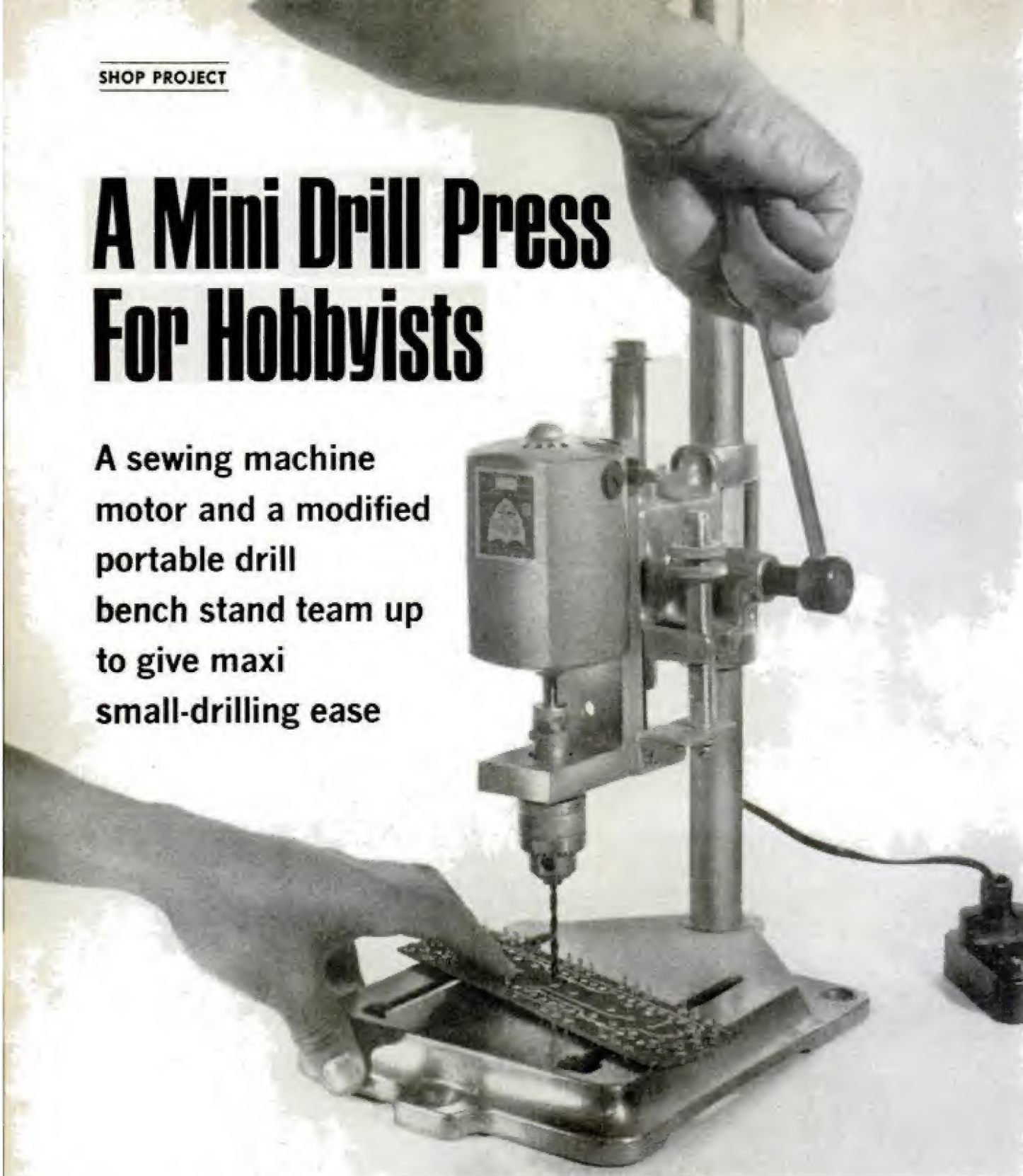
PUSH OF A BUTTON GLUES IT. USM Bostik Spray Glue quickly and neatly bonds paper, cardboard, fabrics, Styrofoam, plastic, fiberglass, glass and metal. This nonflammable, waterproof and pressure-sensitive adhesive has dozens of uses around the home, at school and on the job. It sells for \$1.49. USM Corp., Consumer Products Div., Box 1139, Reading, Pa. 19603.



TEST YOUR BRAIN POWER and ingenuity with Qwik-Sane, a puzzle of 13 pieces in a tray. With only one space in which to maneuver, the object is to slide the pieces around the tray without removing any of those remaining and solving the puzzle in the prescribed number of moves. It sells for \$1.75 (two for \$3) postpaid from Wff 'N Proof Publishers, Box 71, New Haven, Conn. 06501.

A Mini Drill Press For Hobbyists

A sewing machine motor and a modified portable drill bench stand team up to give maxi small-drilling ease

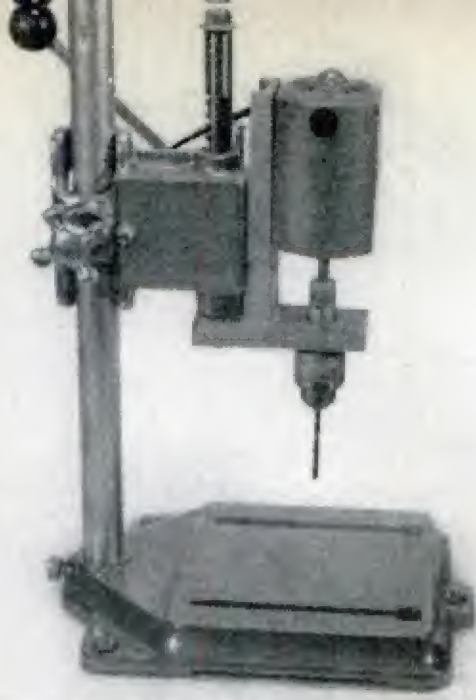


By J. RONALD EYTON

AT ONE TIME or another, all workshoppers who tackle electronic and hobby projects have need for a small drill press. I found this to be true, and, in my case, I also quickly realized that one that featured variable-speed—and more power than any press I could find at retail—would offer even greater workshop convenience. The model shown, which I built in my spare time using a sewing-machine motor, miscellaneous brass scrap

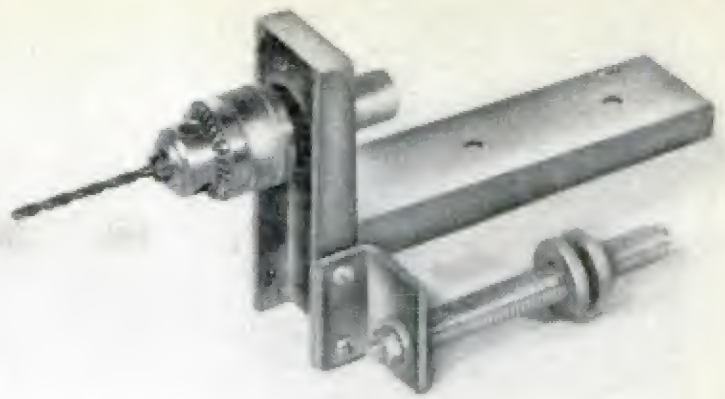
and a couple of store-bought items, filled the bill perfectly.

The press uses a standard chuck which accepts bits up to $\frac{1}{4}$ in. and the motor's variable speed is controlled by a foot switch. The electric motor (catalog No. 41A4006) which generates $\frac{1}{15}$ hp with speed control was purchased from Burstein-Applebee, 3199 Mercier St., Kansas City, Mo. 64111, for \$8.88. Portable electric-drill stands are stocked by hardware



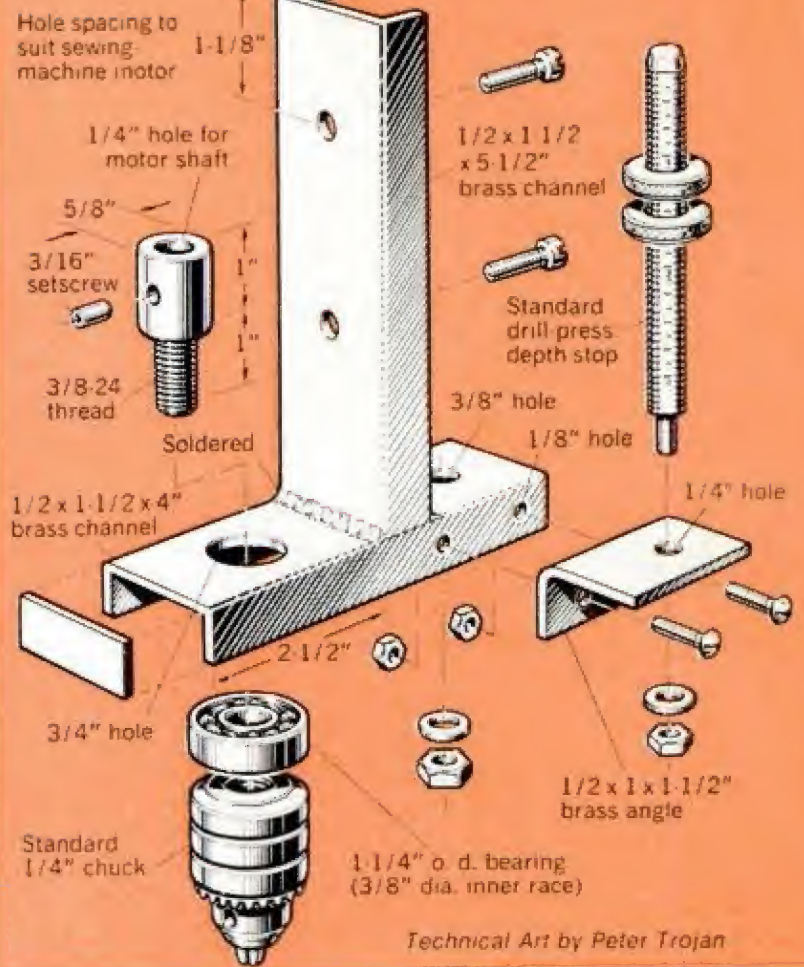
SHOP-BUILT DRILL PRESS has more power than most commercial types, is easily built

DRILL'S MOTOR has variable-speed control activated by a foot switch. Text tells make



STANDARD CHUCK with 1/4-in. bit capacity was used here. Chuck is available at most well-stocked hardware stores

HOW MOTOR SUPPORT IS MADE



stores and any make can be adapted to this setup by making necessary adjustments (Thor's model B-A 37B347 (\$13) was used in this instance).

Dimensions are not critical, and, as with the bench stand, holes can be varied to suit the sewing-machine motor.

Once you have completed the project and mounted the drill press on your workbench, you'll be more than pleased with the tool's efficiency and the convenience it will add to your workshop hours.

★★★

New tools you should know about



FLEXIBLE SPARKPLUG TOOL, claimed to save time, temper and skinned fingers, consists of a rubber gripper which holds plugs firmly and a 1/4-in.-square drive for socket sets. The woven flexible shaft makes it easier to reach hard-to-get-at and recessed places. Tool can also be used on oil-pan bolts; the rubber end will even remove small bulbs safely. \$1.95. L. Crittenden Co., 1201 N.W. 5th St., Oklahoma City, Okla. 73106.



REEL-MOUNTED DROP LIGHT rated at 6 amps, 125 v., comes with a 20-ft., three-wire, grounding-type retractable cord. Cordomatic 500G features a pistol-grip handle of high-impact phenolic, a Levolver toggle-action switch and a built-in convenience outlet for portable power tools and appliances. By mail order from Omar House, 1010 Omar Rd., West Palm Beach, Fla. 33405. The \$15.95 price tag includes the postage.



PRECISION INCLINOMETER/LEVEL that's constructed of durable ABS plastic presents the graduations in magnified view. Called PAV model AP Angle Gage, the level features read-out to 1° with 30-minute estimations possible. Gauge feet are V-grooved for use on rounds such as pipe, and the angle indicator rides on a precision pivot. Priced at \$2.98 by Schlesingers For Tools Ltd., 1020 E. 54th St., Brooklyn, N.Y. 11234.



CONTINUOUS ENGINE ANALYZER labeled Spark Bug is easily installed on a 1-cylinder engine and actually monitors the engine's ignition system. Once connected, the indicator glows brightly if sparkplug and wiring system are operating efficiently; light variation indicates faulty plug, inefficient spark or other causes of sputtering. \$1. Dinsmore Instrument Co., Box 595, Flint, Mich. 48501, is the manufacturer.

HINTS FROM READERS

Increase life of sabre-saw blade

Here are two tricks that get more mileage from your portable jigsaw blades. When necessary to make a panel cut on the floor, place the work on a sheet of plasterboard. On the downstroke, the blade enters the "buffer pad" instead of striking the floor. The shim on the shoe brings new, unused teeth into play to extend blade life.—*George Daniels*

Repair wobbly chair legs

It's quite common for the socket holes in legs and spindles of Early American (or old) furniture to wear oversize with usage and cause a general loosening. For an easy way to insure tight joints when re-gluing, first apply a thin film of white glue on the tenon, then sprinkle sawdust evenly on the dowel end and clamp the part in position.—*Harold T. Bodkin*

Easier metal cutting

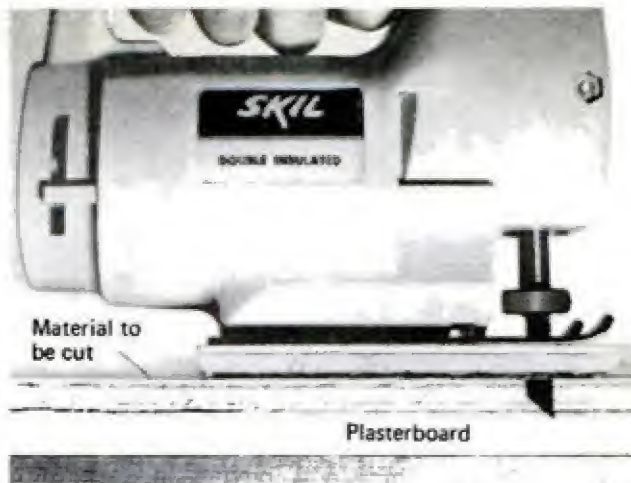
You'll find that hacksaw blades won't dull or break as fast if you use them this way. Instead of inserting one blade in the frame as usual, position two blades with their teeth pointing in opposite directions. You'll be pleasantly surprised to find that sawing will be easier, especially when you're working with thin sheet metal and tubing.—*Blanche Campbell*

Portable drill depth stop

Here's a simple depth gauge you can make from a hose clamp with a hole drilled through, plus some odds and ends you may have lying about the shop. Make sure the binding post wire-hole clears the drill's casing and then fit the rod with a threaded or soldered washer on the end. Simply clamp the unit onto the spindle casing hub.—*Peter Legon*

Painted oar handles

Aluminum oars are nice to row with because they are easy on the arms, but they do have the objectionable trait of leaving the rower's hands black with aluminum oxide after use. I've licked this problem simply by spraying portions of the oars that the hands contact with a good quality metal paint. For best results, use two coats.—*John Krill*





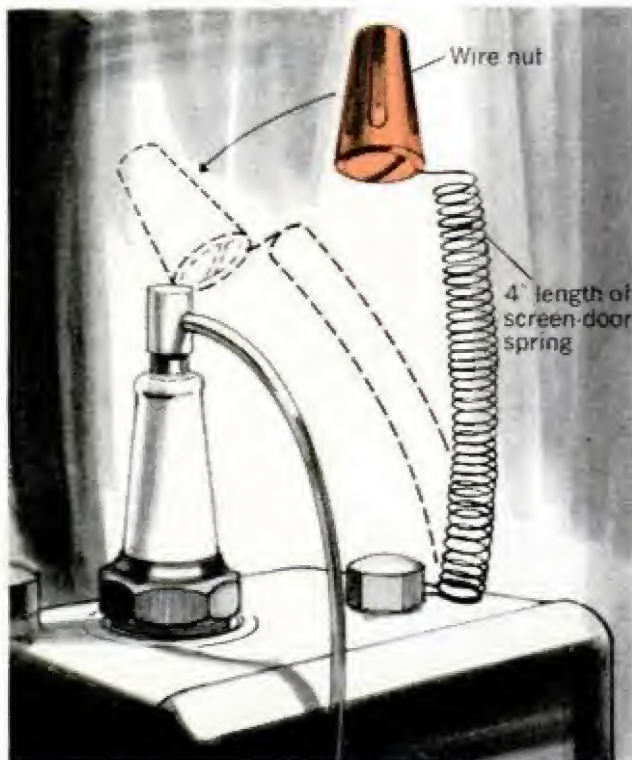
SOLVING



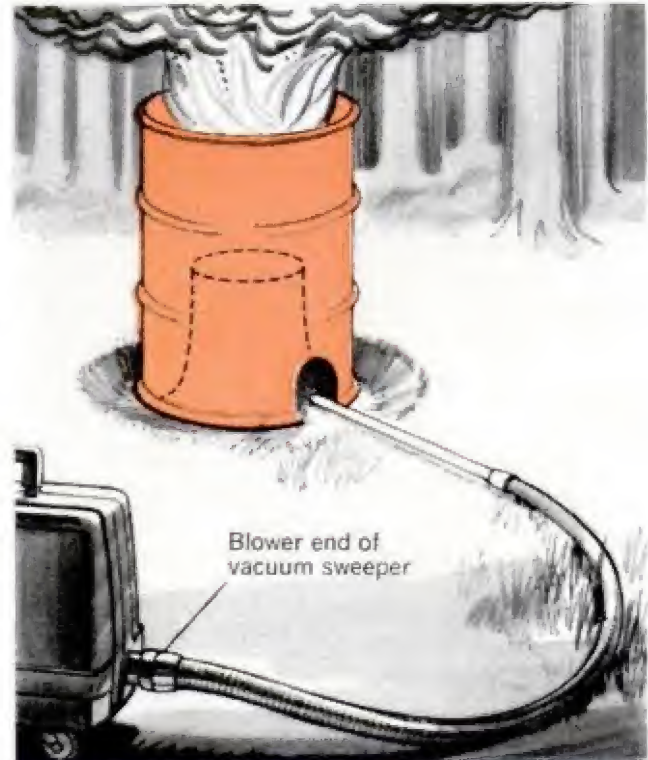
FLIES AROUND GARBAGE CANS are a health hazard during the hot summer months. By bolting a Shell No-Pest insecticide strip inside the cover, I've eliminated these disease carriers completely.—*W. Hitchen*



RUBY REFLECTOR, rubber-cemented to the back of each glove, is good safety device for bike and motorcycle night riders. The reflectors make hand signals visible to oncoming vehicles.—*Joseph Braunstein*



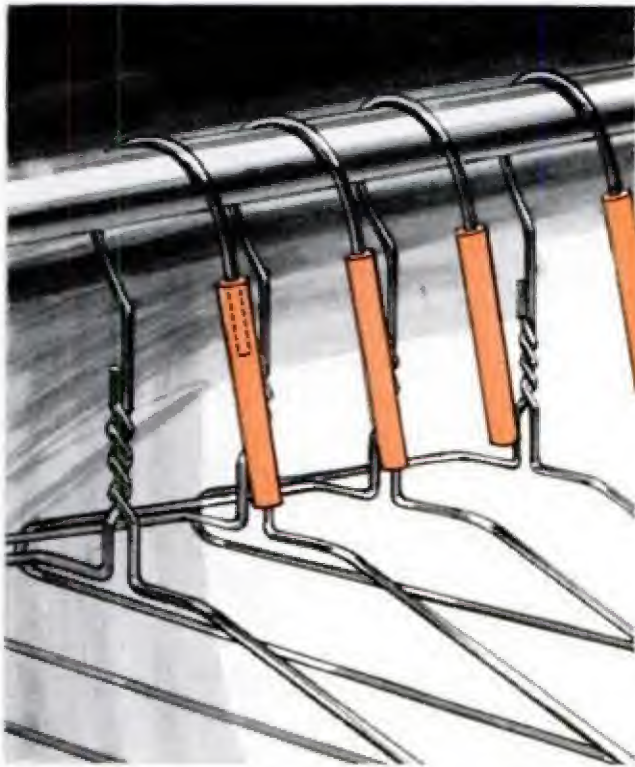
TO SHORT AN OLDER-TYPE GAS MOWER, try a length of screen-door spring. Secure one end under a cylinder-head bolt and the other on a solderless connector to act as a shockproof knob.—*C.H. Hardy*



STUMP WILL BURN QUICKER if you cover it with bottomless barrel and rig up a vacuum cleaner with a length of pipe. Use "blow" end of vac to force air around stump to keep fire burning.—*Leroy Marshall*

HOME PROBLEMS

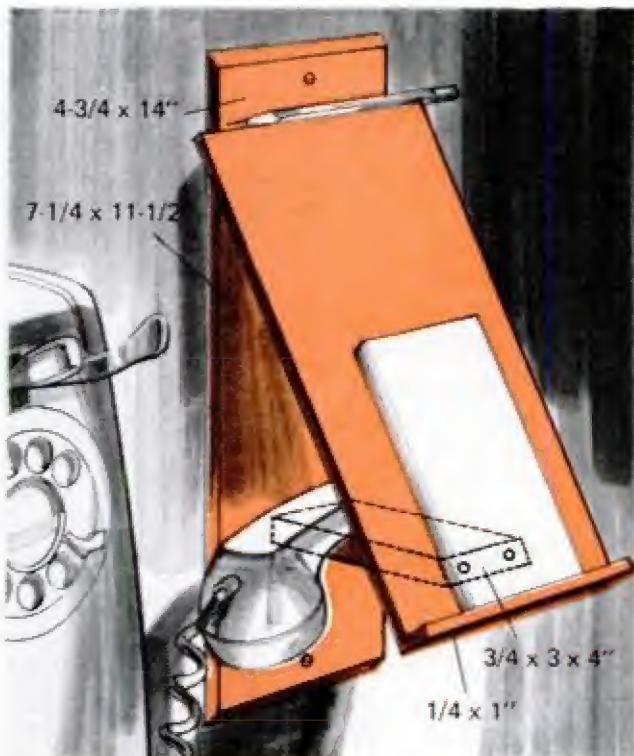
Illustrations by Adolph Brotman, Worman Associates



EMPTY COATHANGERS can be kept on closet poles (instead of falling off every time you remove an article of clothing) by simply slipping pieces of small rubber tubing over the hooks.—*Harry Radzinski*



EMERGENCY SCREEN-DOOR "SPRING" can be made when the stores are closed from a narrow section cut from an old inner tube. Screw a hook to jamb, stretch rubber and fasten to door.—*Wilfred Beaver*



TELEPHONE BRACKET constructed as shown and mounted on the wall near the phone, gives a place to park the receiver. The simple bracket also provides room for memo pad and pencil.—*John F. Dinges*
MARCH 1971



PREVENT CURLED BRISTLES when storing a paintbrush overnight by fastening brush with a rubber band to a slightly longer stick. The stick, not the bristles, will then bear the weight.—*Allen Wilks*



HINTS FROM READERS

Ouchless way to remove pane

Often when you remove a window pane or install a new one, it is necessary to give the glass a few light taps to loosen it or push it in place. If you slip a rubber crutch tip over the putty-knife handle, the latter can be used as a sort of "glazier's hammer" to do the tapping without any danger of breaking the glass.—*William Swallow*



Neat storage rack for hacksaw

A cost-free and easy-to-assemble rack for your hacksaw can be fashioned from a couple of screw-type wire coathooks. Simply position the hooks to suit the saw's frame and screw them in the wall. The bottom hook of each hanger is used to hang the saw, while the upper hook is used to store extra hacksaw blades.

—*William Swallow*



Dust-free storage drawer

If you bend a piece of hardware cloth in the shape of a U and fasten a wood block to each end, you'll have a drawer suitable for holding various shop parts such as those shown. This type drawer is particularly desirable where there is apt to be an accumulation of dirt, dust or rust because it falls through the wire and the contents remain clean.—*B. W. Ervin*



Wire brush 'nibbles' ceramic tile

Lacking a tilesetter's nibbler when I recently tiled my bathroom, I found that a wire brush chucked in my bench grinder does a fine job of cutting tiles to fit around pipes and other odd shapes. The wheel bites the material more readily if you hold the back uppermost and, surprisingly, there is absolutely no flaking or chipping on the glazed side.

—*D. L. Vaughan Jr.*



Pipe fitting serves as small anvil

If you fit a short pipe nipple with a pipe cap and drop it in a dog hole in your workbench, it can be used as a mini-anvil. Because it is not feasible to straighten a nail or the like on the cap's round top, the center of the cap in the photo was "flattened" by machining on a lathe. If the cap has molded letters, these should be filed off.—*William Swallow*

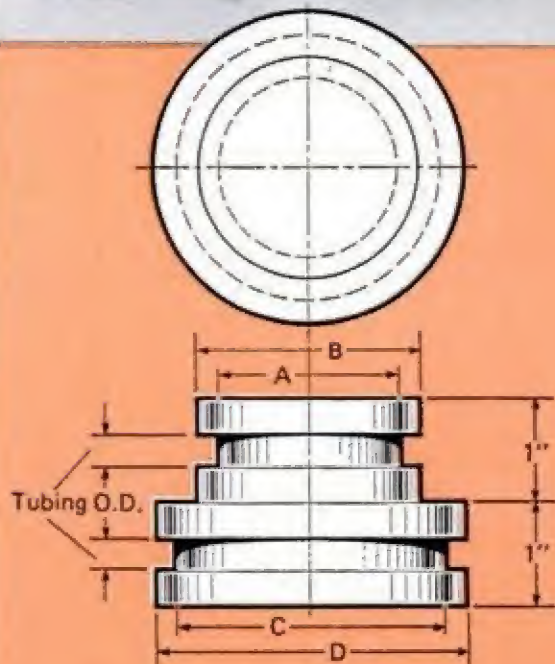
How to Make Perfect Bends In Tubing



MANY HOME INSTALLATIONS call for connections made with small copper or brass tubing. For example, 1/4-in. tubing is frequently used to put a humidifier in an air duct, and oil-pressure and manifold-vacuum gauges usually call for 1/8 or 3/16-in. tubing between engine and dash. Just about any connection you make is sure to need one or more bends.

To make a kink-free bend, you'll need a simple grooved bender like that shown, which can be lathe-turned in minutes from a wood block. Follow the table of dimensions shown below the illustration at the right, for the turning of benders to suit tubing ranging in size from 1/16 through 5/16 in. o.d.

To heat-treat tubing, mark the part of the tube to be bent and heat this area to *dull red* using a propane torch. Then dip it in cold water. (Note: Since copper is a good conductor of heat, handle tubing with tongs or pliers.) To make the bend, clean the surface of the annealed tube by rubbing lightly with fine emery. Place the tubing in the groove of the bender to get the appropriate bend and exert uniform finger pressure to form the tubing around the bender.—*Rudy Kouhoupt*



DIMENSIONS (in inches)

Tubing O.D.	A	B	C	D
1/16	1/2	5/8	3/4	7/8
1/8	1	1 1/4	1 1/2	1 3/4
3/16	1 1/2	1 7/8	2 1/4	2 5/8
1/4	2	2 1/2	3	3 1/2
5/16	2 1/2	3 1/8	3 3/4	4 3/8

Add an Indexing

With it, you can precisely space holes around a disc, space holes around the circumference of a ring—and more. Here's how you can make this versatile accessory

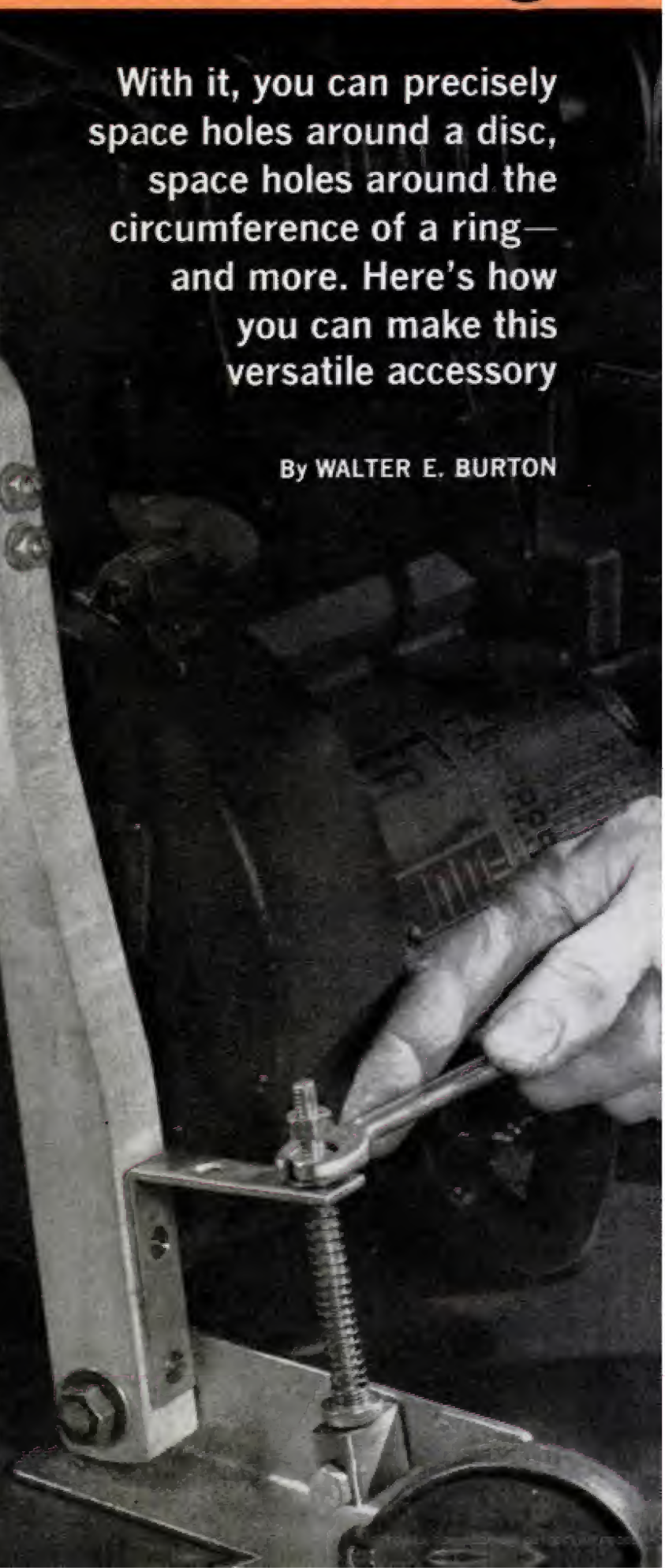
By WALTER E. BURTON

IF YOUR LATHE is equipped with a headstock-spindle indexing attachment -- also referred to as a dividing head or index head -- here are just a few of the things you will be able to do accurately.

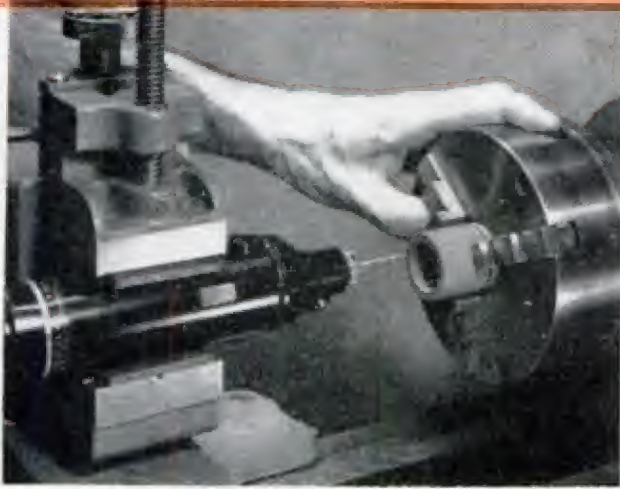
- Drill precisely spaced holes around the edge of a disc.
- Space holes or lines around the circumference of a cylinder or ring.
- Scribe scale lines on a micrometer collar from a machine-control screw.

The attachment is not difficult to make, even though it involves over three-dozen parts. The headstock-spindle indexer shown here was fitted to a 9-in. (Model A, South Bend) lathe, but its basic design can be adapted to other lathes of various sizes.

The indexer more or less naturally divides itself into two main components: First, an arbor that fits inside the headstock-spindle hole, and supports on its outer end the various gears and discs that en-



Attachment to Your Lathe



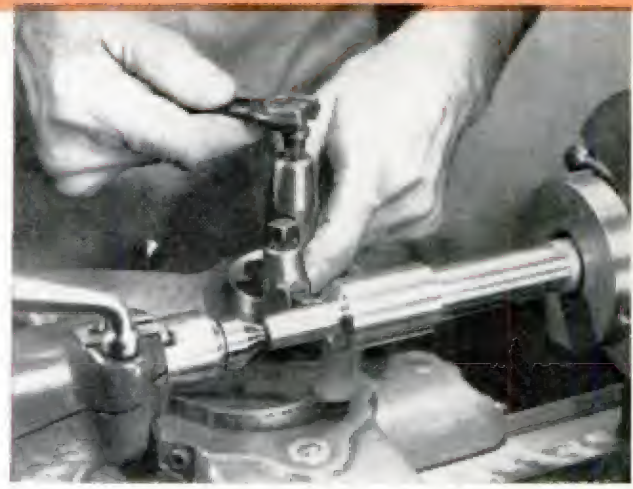
ONE OF MANY JOBS that an indexing attachment enables the lathe to do—drilling precisely spaced holes around end of a Koroseal vinyl-pipe section

able a revolution of the spindle to be divided into, for example, 100 equal parts. Second, a "pawl" (pointer arm), whose job is to provide a latching action for positioning the spindle with respect to the gear teeth. Used with a gear, the arm corresponds to the pawl in a clock-winding mechanism.

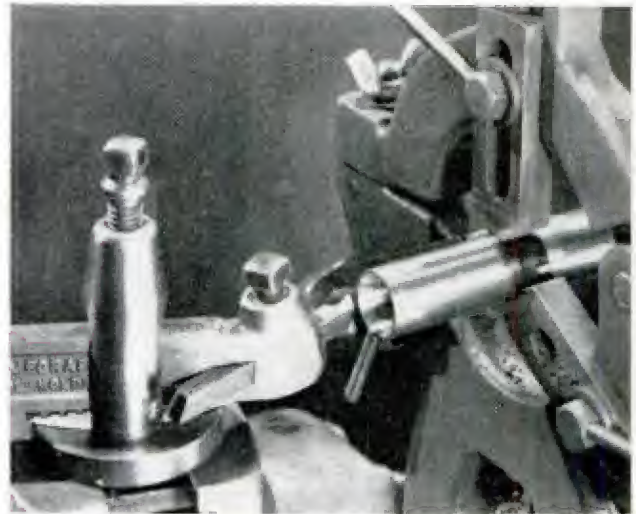
These two units work together to provide easy adjustment of the headstock to various angular positions, while the workpiece, in a chuck or between centers, is scribed, drilled, filed, ground or sawed. During such operations, the spindle can be held against turning by gripping the chuck or cone pulley with the hand, engaging the back gears and grasping pulley and applying a spindle brake. When an attempt is made to move the spindle forward and a gear is used as an indexing plate, jamming the gear tooth against the tip of the pawl arm can provide a degree of locking action.

During indexing operations, no power should be delivered to the headstock spindle; the lathe motor should be switched off. When routine machining is to be done, disengage the pawl-arm assembly and, for safety, remove the indexing gear, too.

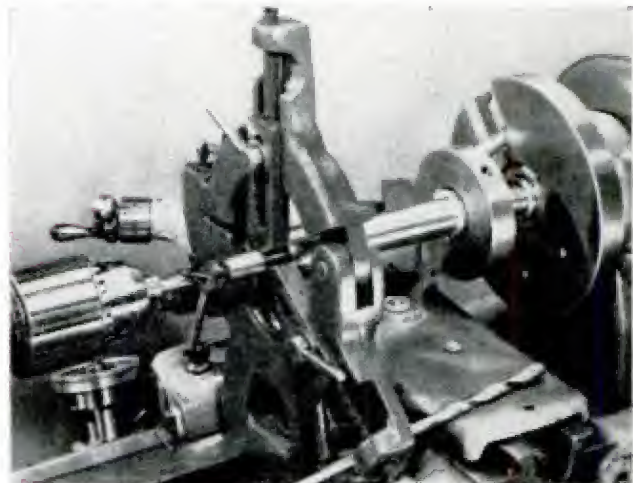
● *The arbor unit.* To mount, at the outer end of the headstock spindle, a gear or disc providing the indexing divisions, an arbor is inserted into the spindle and locked with an arrangement resembling a collet-chuck setup. The arbor body is



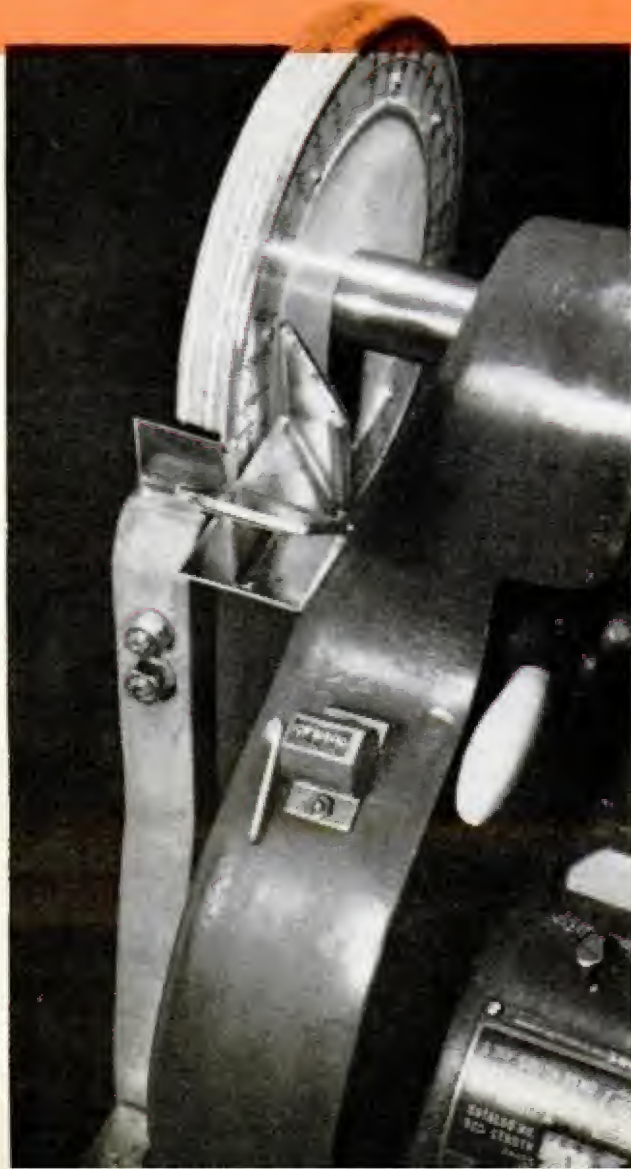
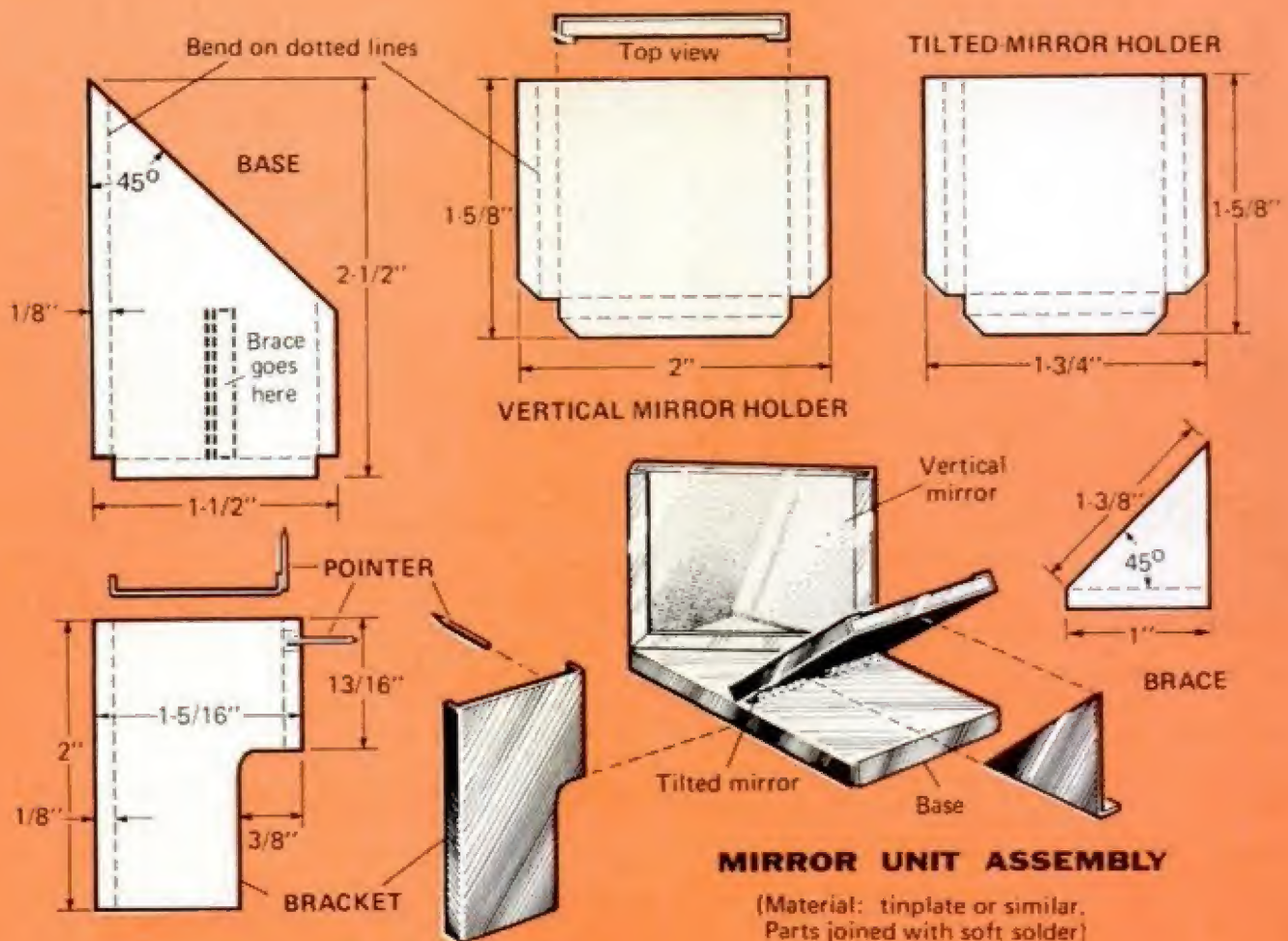
MACHINING ARBOR BETWEEN CENTERS: Tool is working on an end that will be the outside spindle and on which the indexing gear or disc is mounted



COLLET (INSIDE) END OF ARBOR was bored to the diameter shown in drawing, then a 15° taper was turned using the compound slide to control the tool



TO DRILL LONGITUDINAL HOLES through arbor, shoulders rotating against steady-rest jaws hold arbor on headstock center. Long ¼-in. bit eased job

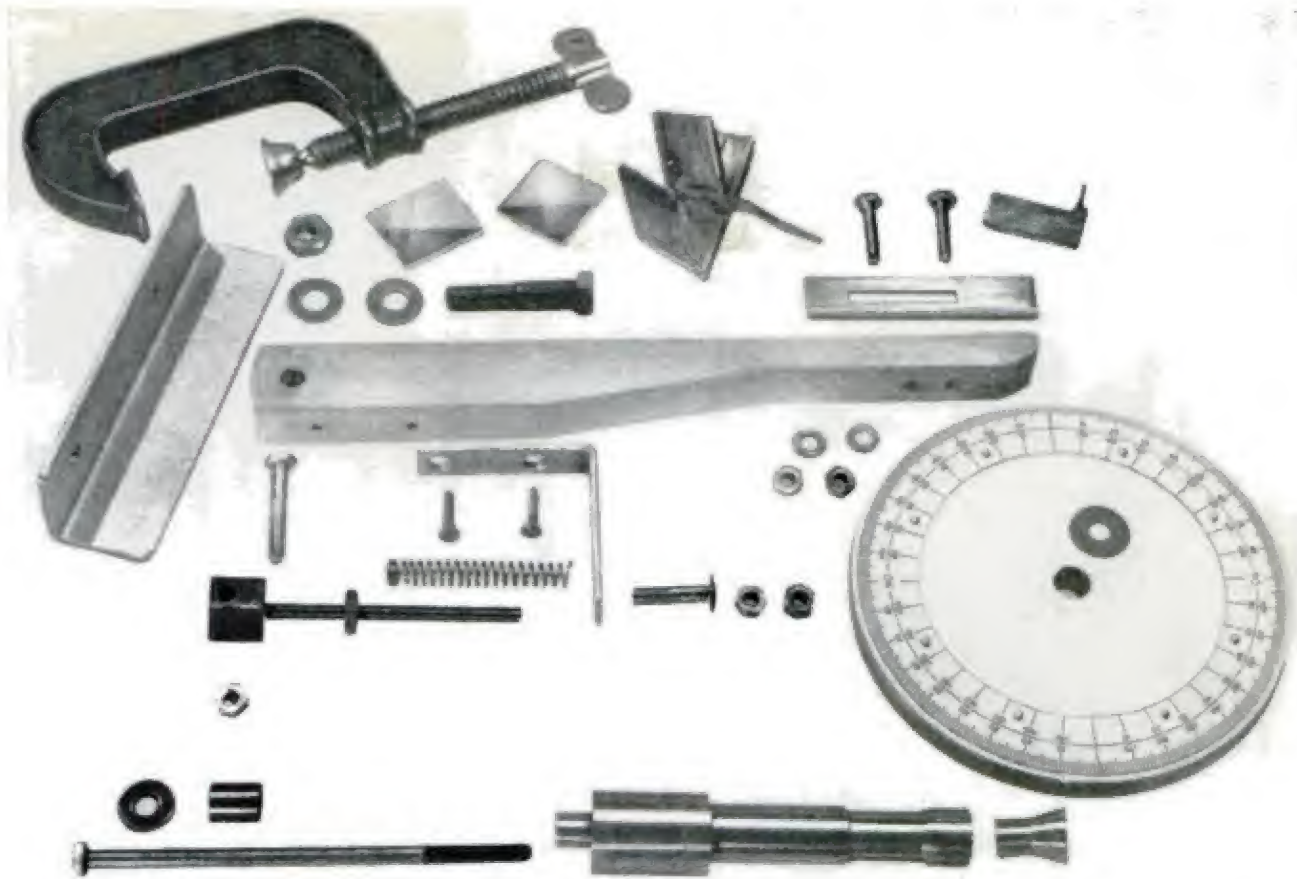


made from cold-rolled or tool steel and shaped as shown in the drawings. The portion that goes into the spindle fits the hole rather snugly, and itself has a bore that ends in a 15° taper. The walls of this bore are divided into four segments by longitudinal saw cuts which extend back for about $1\frac{1}{2}$ in. A machine bolt inserted through the outer end of the arbor has, as a nut, a colletlike "plug" whose larger diameter is machined to a 15° taper. When the bolt is tightened, it draws this collet plug into the bore of the arbor, and the tapered surfaces cause the segments between saw slits to expand against the wall of the headstock spindle, locking the arbor in place.

At the same time, the bolt head clamps the gear or indexing disc tightly against the outer end of the arbor. Make bushings as needed to accommodate gears or discs of various thicknesses.

Projection of the arbor beyond the spindle end should be such that the gear or disc clears all adjacent parts of the lathe—

THIS SETUP USES A MIRROR instead of pointer. Scale is seen by looking down at comfortable angle



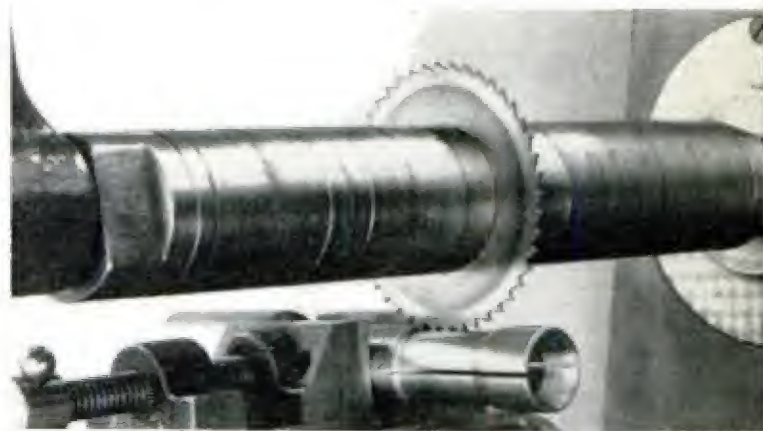
ESSENTIAL PARTS of the indexing attachments are shown above. Notice that they include an angular degree disc that was made from two 10-cent plastic protractors purchased at a five and dime store

such as the safety cover over the lathe-gear assembly.

● *The pawl arm.* It can be called a "pawl arm" because its action against the teeth of a gear is much like that of a pawl in a ratchet arrangement. The unit shown is mounted on the benchtop close to the lathe, but some latches might be of such construction that a similar latching device could be attached directly to the headstock area. It was found desirable to use a C-clamp, rather than bolts or screws, to hold the pawl arm in position; this permits quick adjustment or removal and replacement.

The arm itself, in the model shown, was made from maple with an overall length of 11½ in. (This might vary with different lathes and different angles of inclination of the arm.)

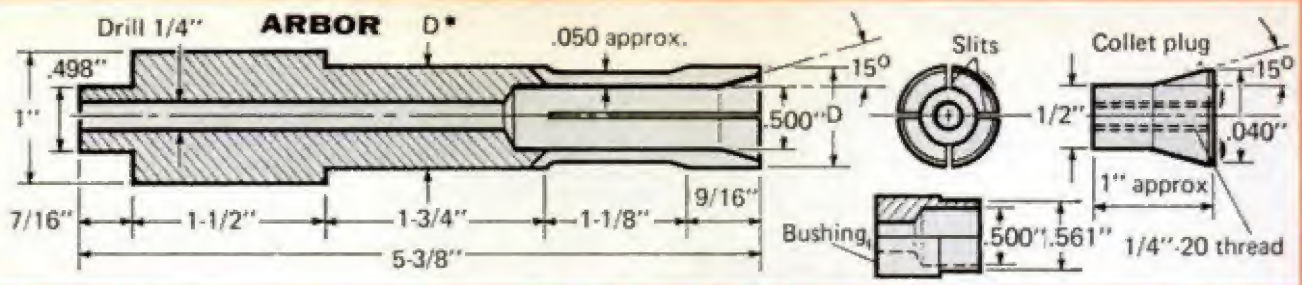
The bottom end of the arm is bolted to a piece of angle iron acting as a base, the bolt fitting snugly in the hole in the wood but the arm being free to swing. The hole could be bushed with brass or bronze. The bolt hole in the angle-iron base is threaded (¾ in.-16), and a locknut used to prevent the bolt from turning. A thin



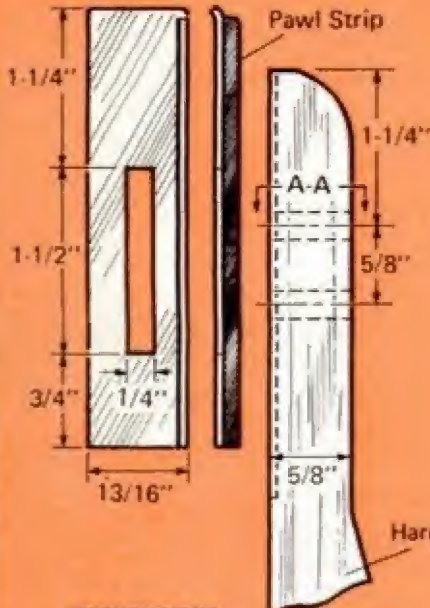
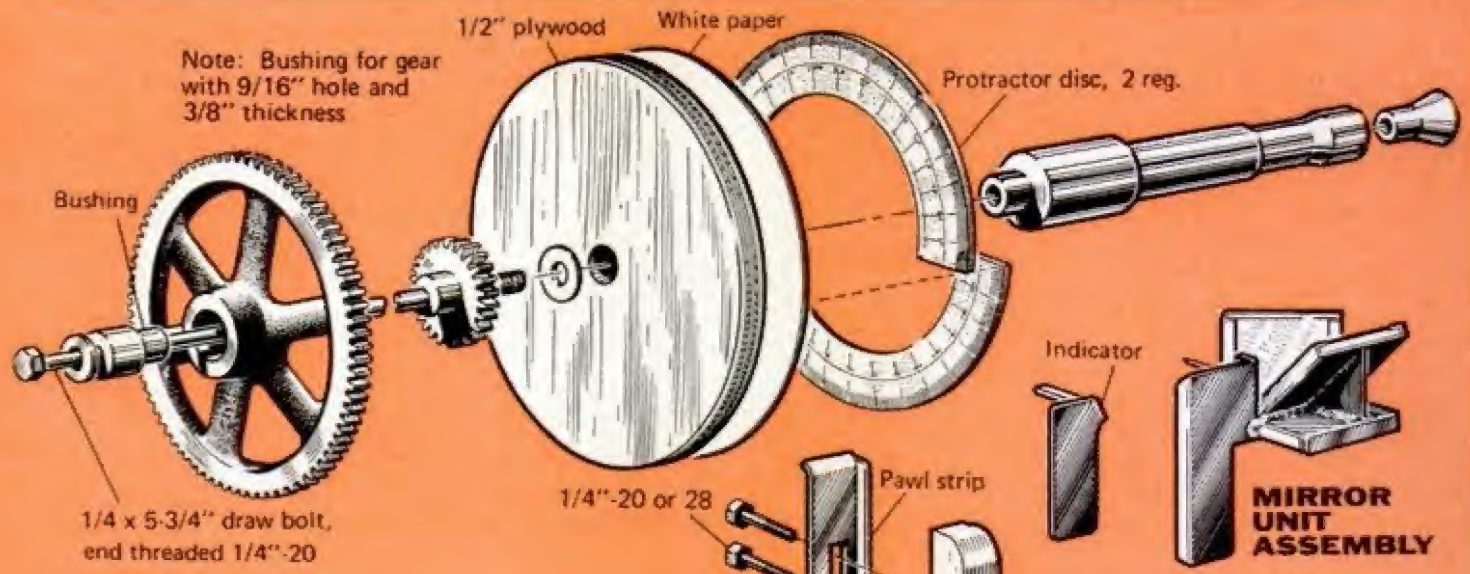
SLITTING SAW used on milling machine separates the collet end of arbor into four longitudinal segments

washer is used between arm and base; it can be a smooth, slightly-curved spring type rather than split.

To maintain pressure of the arm against a gear used as an indexing plate, a coil spring arrangement was devised as illustrated. A conventional ⅝ x 2½ x 2½-in.-steel angle brace was screwed to the wooden arm and its outer hole enlarged to slide freely over a pivoted ¼-in. threaded rod encircled by the coiled compression spring. Nuts on the rod enable the spring pressure to be controlled and

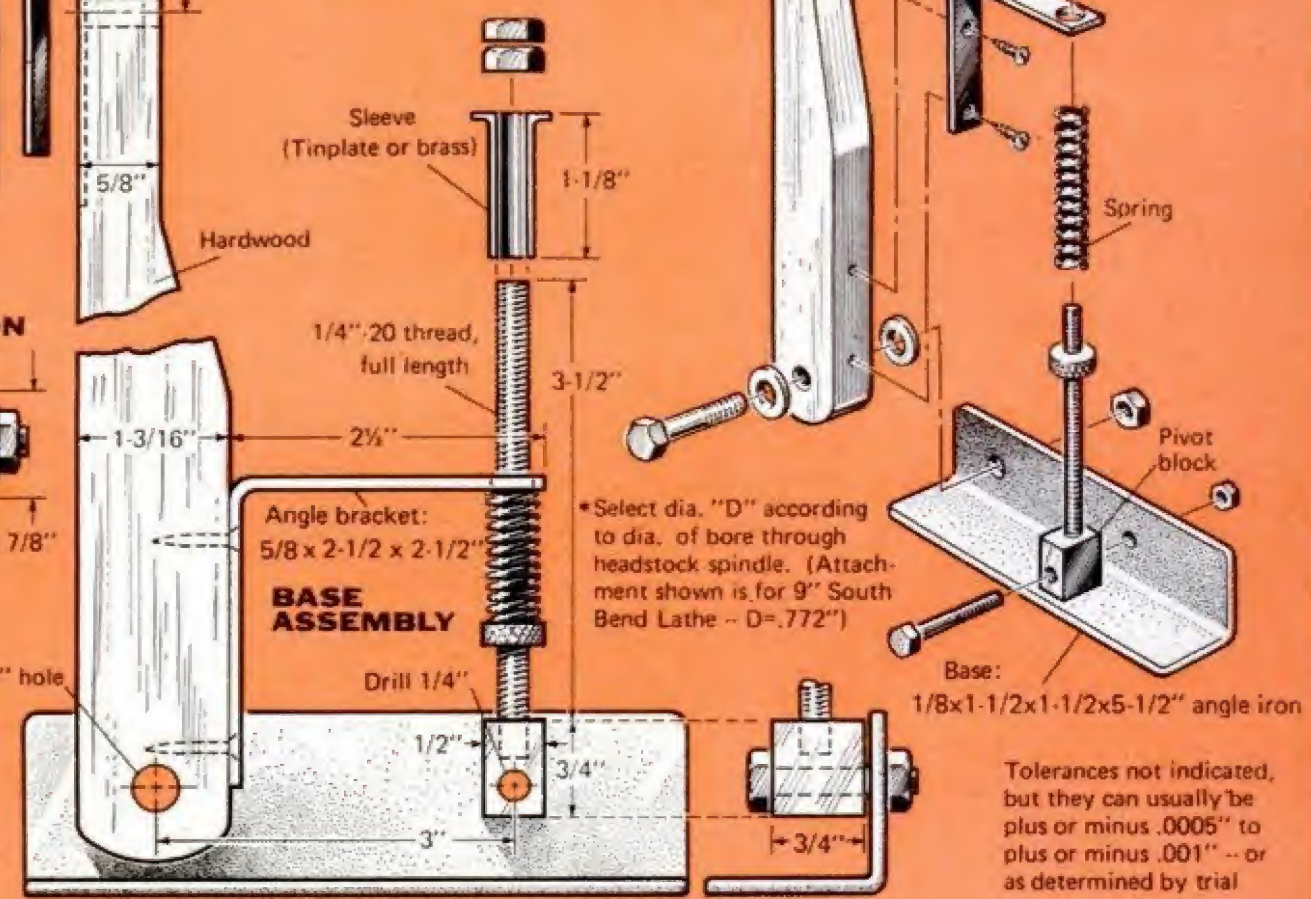
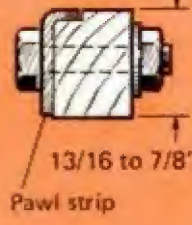


Note: Bushing for gear with 9/16" hole and 3/8" thickness

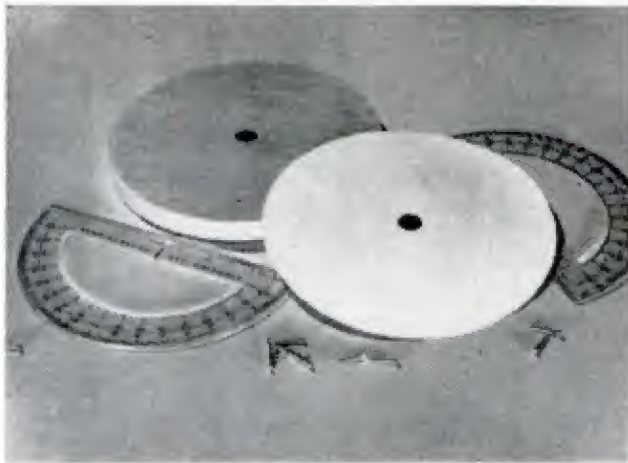


Technical Art by Fred Wolff

SECTION A-A



Tolerances not indicated, but they can usually be plus or minus .0005" to plus or minus .001" -- or as determined by trial



ANGLE-MEASURING DISC consists of two 6-in. 180° protractors; white paper beneath makes reading easy

the arm movement toward the spindle limited. A sleeve made from thin sheet metal is inserted between the threaded rod and hole in the angle bracket, so the bracket can move smoothly instead of being hampered by the threads. The pivoted block from which the threaded rod projects is mounted, on a 1/4-in. bolt (the same as the arm).

The angle to which the arm can be inclined is found by trial; it depends somewhat on the shape and position of the adjustable steel "pawl strip" at the upper end of the arm. This strip—the one shown was cut from a piece of 1/16 x 3/4 x 3/4-in. angle iron—acts as a pawl to engage the indexing-gear teeth. Its upper end is bent or otherwise shaped so it presses firmly against the tooth that is just above it when this end is positioned about level with, or a little below, the headstock-spindle (and gear) centerline. The strip must be adjustable lengthwise so it can be aligned with both large and small gears when the arm is swung to different angles.

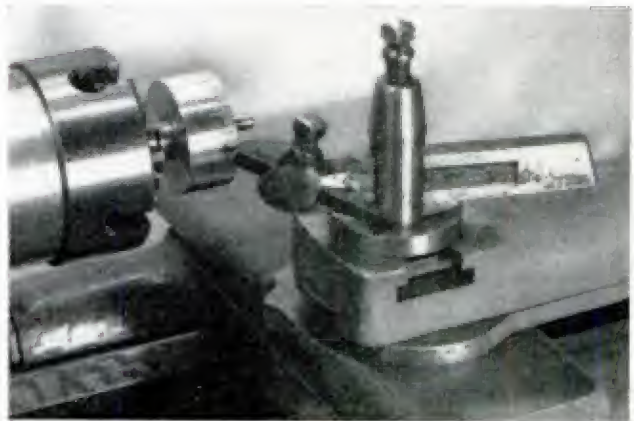
Although the "pawl strip" shown was cut from angle iron and has one turned-back edge which helps prevent it from shifting laterally, it could be simply a 1/16- or 1/8 in. flat piece of steel.

In indexing, move the spindle backward by hand until the pawl clicks into the desired space between gear teeth. Then reverse the spindle so the pawl presses firmly against the uppermost tooth and hold it in that position while the workpiece is scribed, drilled and so on. There should be no "give" in the pawl-arm assembly under pressure of a gear tooth against the pawl strip.

● *Degree-measuring disc.* The ability to
MARCH 1971



PROTRACTOR EDGES are concentric with a center hole. Simple pointer is cut from a sheet of aluminum



SCRIBING SCALE LINES on micrometer collar is an easy task using the indexing attachment shown here

index lathe work with respect to angular position in degree is handy. For this operation, a disc calibrated in degrees of angle is mounted on the spindle arbor, and a suitable pointer fitted to the tip of the pawl arm.

Two 180° protractors were mounted on one side of a 6-in. disc of 1/2-in. plywood. Unneeded portions of the protractors were carefully cut away with a jeweler's saw. Brass escutcheon pins through drilled holes secure the segments to the wood. A white paper underlay is used to make division marks easier to see. Care was taken to match the protractor halves so the degree divisions remain uniform at the joints.

Perhaps a minor disadvantage of this arrangement is that the scale is on a side of the disc instead of the rim. The simplest indexing pointer for such a scale consists of a piece of sheet metal (such as aluminum) having a projecting point. It is clamped between the tip of the wooden arm and the pawl strip. If you will hold your head at about the same position

each time, the scale readings obtained with this simple pointer can be reasonably uniform.

An optional arrangement that seems more accurate consists of two small mirrors mounted to reflect an image of a pointer (short piece of wire) and a portion of the degree scale, for convenient viewing without your having to stoop and look sidewise. By holding your eye in about the same position each time, you can achieve easy, uniform readings.

If a tiny dot of black lacquer or marking-pen ink is put on the mirror nearest your eye, you'll see two dots close together when you look into the system—one being the original dot and the other its reflection from the mirror back surface. Visually, these dots are a fraction of an inch apart. Each time, if you hold your eye so the indexing pointer seems to be halfway between the dots, you can assume you'll get a negligible variation between readings.

An alternate way of calibrating a disc in degrees is to mark, on the circumference, a scale dividing the space exactly into 360 parts—or it may suffice to divide it into, say, 5° or 10° sections.

Gears suitable for indexing should be new or uniformly worn, so teeth spacing does not vary. Usually there are several loose gears with a screw-cutting lathe, and these can be fitted to the arbor.

To scribe lines on workpieces under control of the indexing attachment, adjust

a pointed bit in the toolpost holder until it will plow a shallow line neatly in the work as the carriage, or cross or compound slide, is moved. Or, for an alternate method, you could clamp a vibrating tool on the carriage and use its point to engrave the lines.

To drill holes, you can: 1. Clamp a small hand grinder (with drill bit in its chuck) in a carriage-mounted milling attachment; or otherwise fasten grinder to carriage; 2. Similarly mount an electric drill; 3. Use a toolpost grinder equipped with drill chuck; 4. Use a hand or electric drill with bit operating through a hole in a jig mounted in fixed position on carriage or slide.

To form flats, as in making a hex on a bolt blank: 1. File the flats with aid of a guide that limits depth of cut; 2. Use a milling attachment having a rotary cutter driven by a motor on the attachment; 3. Use a grinding wheel on a toolpost grinder, electric drill or hand grinder mounted on carriage.

To cut slots and grooves: Use a slitting cutter driven by a toolpost grinder, electric drill or other power unit mounted so length and depth of cut can be controlled by carriage slides.

A scale can be made on flat sheet metal by fastening the blank around the circumference of a cylindrical mandrel and engraving the scale lines on the blank in the same way as you'd calibrate a micrometer collar. ★★★

NEXT MONTH IN SHOP AND CRAFTS

FROM-SEA-TO-SKI VACATION HOMES. More and more of today's families are looking toward a second home as an investment as well as a retreat from everyday living. *PM's* annual round-up this year includes eight houses you can buy or build, as well as an improved version of the house that was most popular with readers last year. Look for these exciting leisure homes in the April issue of *PM*.

BUILD THIS CABANA FOR YEAR-ROUND USE. A trim little lawn house built next to your pool can save your floors from wet footprints because bathers will have a place to change. And if you plan ahead, the same building can be put to storage use in the off season. Pick up an April *PM* and build your own.

ALL-TIME GREAT NO. 5: BUILD THIS OLD-TIME SWING FOR YOUR YARD. It's the same kind that Grandpa did his spooning in, and you'll find this delightful piece of lawn furniture has lost none of its original charm. Complete instructions including how-to-build plans, are in *PM* next month.

BUILD A CONTEMPORARY PEDESTAL TABLE. This project adds a new and interesting technique to your workshop know-how. You'll be able to turn out hi-fi speaker bases, lamps and other fascinating modern furniture. See next month's issue.



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But should you forget (and even if you don't), you'll be glad you remembered Valvoline.

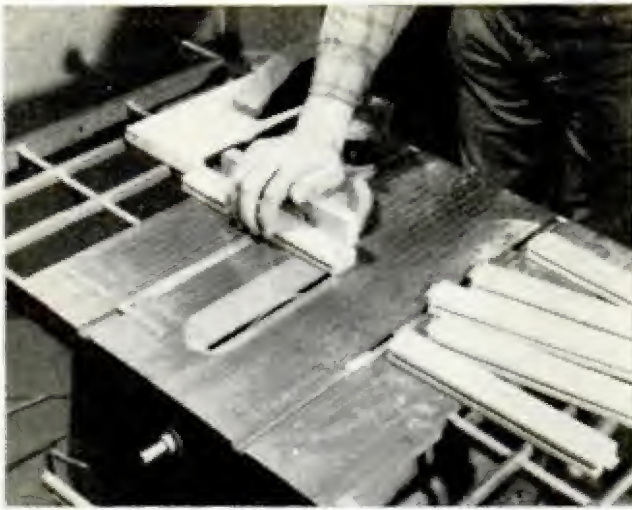
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always remember
to change their motor oil.

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OAK FRAMING PIECES are cut to size on table saw. The new tongue must be formed on the cutoff side

TAPE A PIECE OF PAPER to the plastic panel inserts to facilitate both marking and bandsaw cutting

MAKE A GRAND ENTRY

(Continued from page 147)

require a stepped-lap to fit into the rabbet. Drop the X into the frame and repeat the procedure with the smaller Xs.

Number all of the pieces so that they don't get mixed up, then disassemble them and cut a $\frac{1}{8} \times \frac{3}{8}$ -in.-deep kerf along all the sides to contain the plastic inserts. Reassemble the parts and apply a router to both edges of the inside face with a shaped cutter. Filler strips which lie in the rabbet between the cross pieces should be included in the routing operation.

Cut the plastic inserts oversize so they rest in the grooves and the rabbeted setback of the outer frame. Use a fine-tooth saw blade and sand off any burrs before the final assembly. A dab of General

(Please turn to page 180)

DOWELS are used to beef up corners, and a partial groove must be cut where arched insert intersects



FOR NEAT JOB, paint the grooves before installing plastic. Use a few drops of glue for added strength

OLD TRICK of running many parallel saw kerfs into oak frame for arch makes frame easily bendable





Santa Fe tests coaxial train

An unusual coaxial train, built to one-eighth scale, is being tested at the Santa Fe Research and Development Laboratory in Topeka, Kans. The model features a continuous center "sill" running the length of the train, with no coupling devices. Individually powered wheels are spaced at four-foot intervals, each fastened to the center sill and to a "wheel deck." Among advantages of the design are even weight distribution, less wheel wear and low center of gravity.

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WATER-SOLUBLE GLUE, mixed with fine sawdust, is brushed into the kerfs, serves as an effective filler



BEFORE GLUE DRIES, flex the strip to desired arch by bridging preset nails. Scrape off glue ooze-out

MAKE A GRAND ENTRY

(Continued from page 178)

Electric's Silicone Seal is used in each groove to keep the plastic inserts from shifting about. This material is pure rubber, which remains flexible, thus preventing any expansion problems. Varnish the inside, paint the outside and then add the plate glass which is secured with a molding frame.

● *New archway.* Similar procedures are used to build the archway. The oak framing is a stock building-supply-house accessory item grooved to accept either the filigree or plastic panels. It is available in 8-ft. lengths and 2-ft. cross pieces. The cross pieces have tongues at both ends to fit into the uprights. Our units require smaller cross members so it will be neces-

(Please turn to page 182)



USE A SPOKESHAVE to round off the 1/8-in. plywood facing that must be added to one side of frame

TO MARK CURVED STRIP for an accurate joint, clamp it in place (below left). When satisfied with the fit, apply glue to the groove, force the arch into place and hold with brads well set into predrilled holes



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MAKE A GRAND ENTRY

(Continued from page 180)

sary to cut them down to size and form a new tongue on the cutoff end.

The upright sections are made as separate units, using dowels on all corners to gain extra strength. Before assembling the foyer divider, which was ultimately painted black, it proved to be advantageous to paint the inside edges and the grooves in advance. This permits you to coat the inside of the grooves, which otherwise would show up nonblack through the plastic panel.

Forming the arches

It is not difficult to form the curved section of the arches if you follow a time-honored cabinet-making technique. The $\frac{3}{4}$ x $1\frac{1}{2}$ -in. oak framing is about as rigid as a piece of steel. So the only way to produce the curve is by means of kerfing—a series of saw cuts partially through the wood at close intervals. This “breaks the back” of the wood, rendering it quite flexible. The job is generally done with a circular saw which makes a rather wide kerf. Instead, I used the band saw to produce a finer cut. Make a series of cuts through the solid edge $\frac{3}{8}$ in. apart down to within $\frac{3}{8}$ in. from the grooved edge.

Determine the amount of curve desired and draw the curve onto the worktable. Next, partly drive nails in positions that will hold the piece in this curved condition. Remove the piece and cover the area with wax paper to prevent the workpiece from gluing itself to the table. Make a pasty glue by mixing in some fine sawdust. Brush the mixture well into the crevices, both sides, and place the strip onto the jig bending it around the nails. Use a scraper to remove the excess before it hardens. When it's dry, clamp the piece in place over the upright sections to mark and cut off any excess at the ends.

The $\frac{1}{8}$ -in. plywood backing glued to the curved piece serves two purposes: First, to reinforce it and, second, to provide a simple means for attaching to the uprights. The plywood can be glued on oversize and trimmed in place later. Leave sufficient overhang to form a “wing” on each side. The wings form built-in brackets which are screwed into the uprights.

The corresponding verticals are similarly framed but, for looks, make the inserts of hardboard filigree. Here, again, you'll speed the job if you complete all the carpentry first, mark the pieces as you cut them for easy reassembly later, and then paint the filigree outdoors where you can spray it, rather than spend unnecessary time fussing with a brush. ★★★

BUILD THE YELLOW JACKET

(Continued from page 129)

thinwall steel tubing. With no bends involved, the sections are simply cut to length and welded together.

The thin aluminum skin sections are cut to shape with tin snips, then “Pop”-riveted into place. The duct intakes and nose section are fiberglassed.

To build the fins, you will need to make a few breaks, but you don't need any fancy equipment. Just clamp the aluminum between a pair of 2x4s and bend it over gently with a plastic mallet. Start at one end and work toward the other. By making two or three passes along the edge with the mallet, you can produce the bends cleanly.

Fan blades are laminated spruce

The fan blades are made separately of laminated spruce. Once shaped and finished, they are glued and bolted to a 14-in. aluminum disc. This assembly is then bolted to the hub, which is merely a short section of chrome steel tubing.

If you have money to burn, and you don't want to tackle the job yourself, take the pattern (provided in the plans) to a prop maker. He should make you a set of fans for around \$250. But with a little patience and a rented router, you can shape, assemble and balance your own fans for less than \$60.

The power is provided by two Chrysler 820 go-kart engines. These engines sell new for \$139 each. However, with the popularity of go-karts, used engines are available for less.

Top speed better than 50 mph

“I don't really know the top speed of Yellow Jacket,” Eugene reports. “I usually shut it down between 45 and 50 mph, but it feels like it will keep on gaining speed.” It's very slow to accelerate up to about 25 mph, but at this speed, the aerodynamic lift on the fuselage comes into effect. Then, he adds, “Yellow Jacket suddenly rises about 3 in. and takes off hell-bent for leather.”

Unlike most air-cushion vehicles in this power class, Yellow Jacket gets up high enough to clear small obstacles. Fascinated, I flew it back and forth over a 5-in.-high street curb waiting for a bump that never did come.

So if you don't mind your neighbors thinking you're a little eccentric, and you can accept the limitations of an air-cushion vehicle, building Yellow Jacket might be your cup of tea. It's a jazzy little rig and you'll get more than \$400 worth of fun from it. ★★★

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Build an auxiliary table to enlarge your band saw. Your 12- or 14-inch band saw will cut anything you can get under the blade guide. The problem is to support and guide a large workpiece while it is being cut. Here's a 3 x 4 foot plywood table that gives any small band saw big-machine capacity and flexibility. Plans help you do it inexpensively.

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Children love the Free-Flight Parashut Plane. Build this model for your children and you'll get a big hand at any flying competition. It may look like a flying dinner plate, but this way-out model is a rugged performer.

Brazing fixture for band saw blades. You can save half on blade costs if you buy bulk 100-foot rolls and make

your own. But you have to know these steps to silver-solder the joints.

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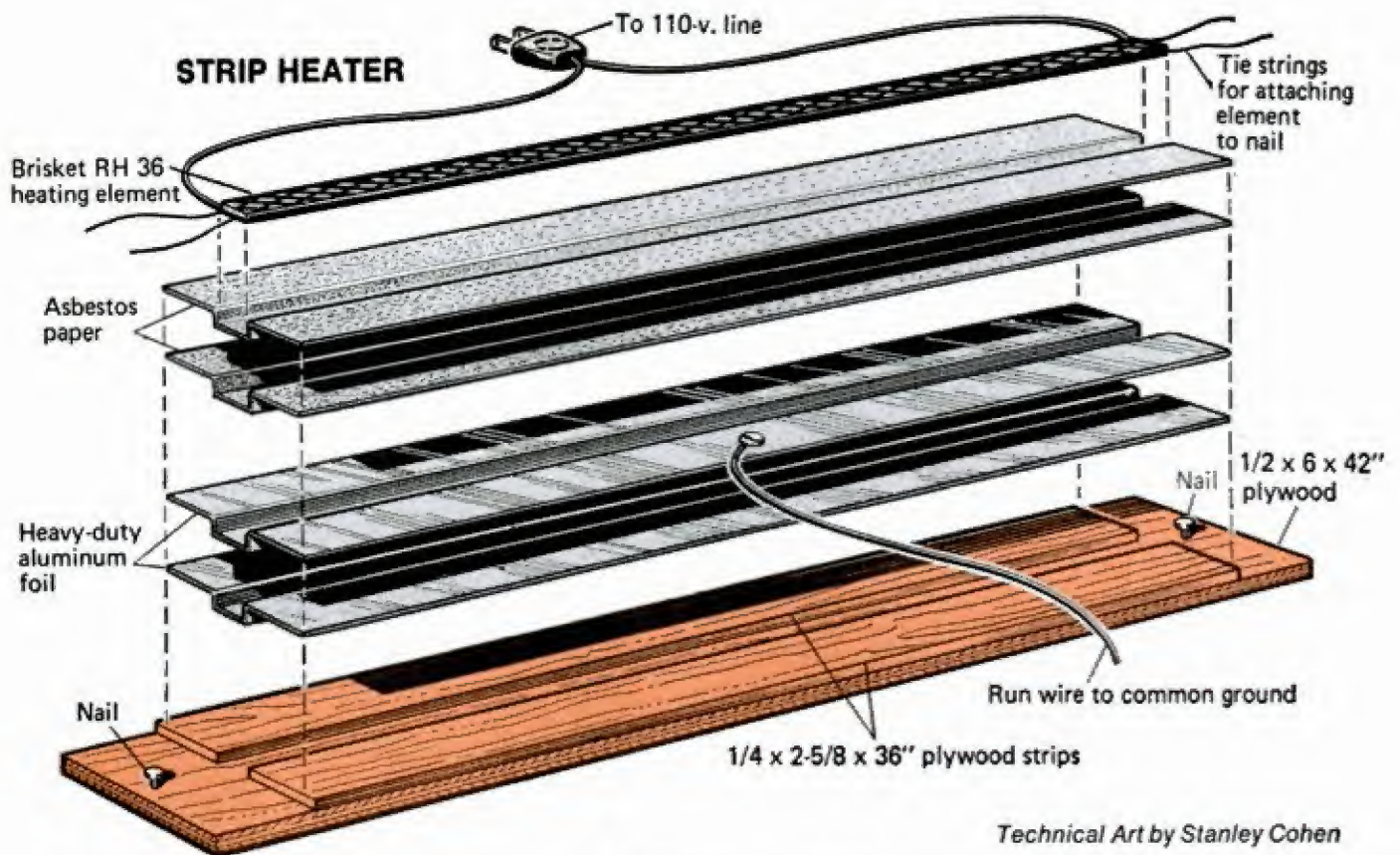
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Technical Art by Stanley Cohen

PLEXIGLASS PROJECTS

(Continued from page 150)

it is particularly important that you make accurate 90° bends. Hold the bend until the plastic cools.

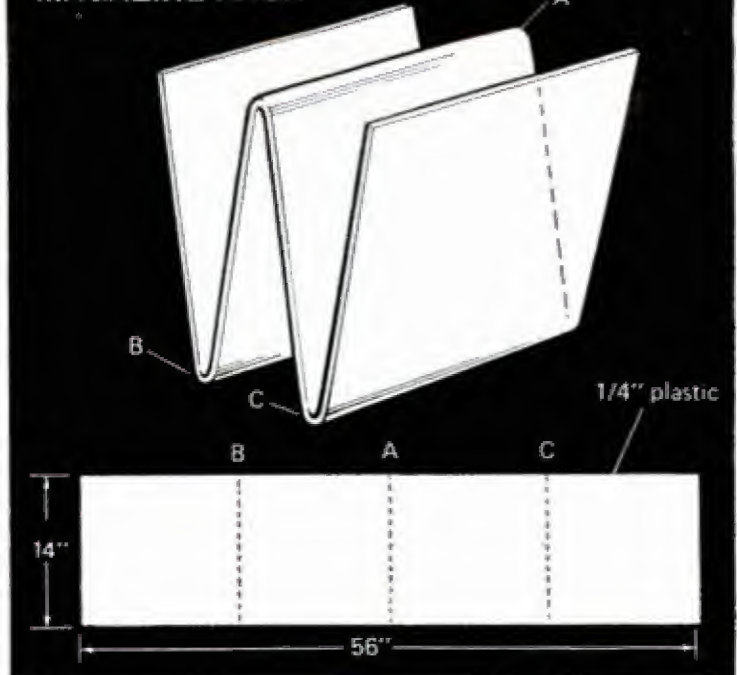
All exposed edges of the plastic for whatever project you're making must be polished, which is done by first sanding with a medium-grit (60-80) paper, then with a "wet or dry" (150) grit and progressively finer grits up to 400, and finally, by polishing with a cloth (muslin) wheel charged with jeweler's rouge or fine-grit buffing compound which you can get in bar form at Sears. To save time, bind four panels together and polish the edges simultaneously. The finished edges will look like glass.

Edges to be cemented are sanded *only*, not buffed. Use tabs of masking tape to hold the pieces in position and apply the cement to the joint. The waterlike solvent will flow into the joint by capillary action and immediately fuse the plastic. Let the joint dry for 20 minutes or so, then remove tape.

A new hypodermic-type applicator places the solvent without spilling a drop outside the seam. It sells for \$2 and works much better than the eyedropper I had been using. The element for the strip heater sells for \$8. You can buy both element and applicator from Rohm and Haas Co., Box 9730, Philadelphia, Pa. 19140.

When using the homemade, plug-in

MAGAZINE RACK



heater detailed above, do not let the plastic sheet touch the heating element and do not heat the material higher than 340° F. since surface overheating will cause scorching and bubbling. In heat-forming the phone stand, I had no trouble when I heated the plastic for 10 minutes. I placed the sheet across the top of the heater and timed each bend with an oven timer. Bending the sheet before it is soft enough will cause stress crazing (small internal fractures) at the bend. Don't try to bend plastic over 1/4 in. thick. ★★ ★



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TRIPODS UP TO NEW TRICKS

(Continued from page 143)

as you fumble around to thread the mounting screw into the socket. Now there are quick-mount arrangements that speed up the job. On some tripods, you screw the mounting stud only part way into the camera socket—just enough for a good grip. Then you spin a knob with a fast-spiral thread that quickly draws your camera down snugly against the head of the tripod.

Another instant-mount system, used on Hollywood's Futura tripod, is based on a small cone-shaped fitting that's screwed into the camera socket and left there. To attach the camera to the tripod, you just slip the cone into an opening in the head and flip a lever to wedge-lock the cone and camera firmly in place. If you want to mount several different cameras interchangeably, you can buy extra cones, one for each camera used, and leave them attached. Other types of quick

Take your camera to the store and actually try it on several different models.

mounts are available as accessories and can be used on any tripod.

Most tripods have dual-action pan-and-tilt heads that swing up and down for vertical aiming and sideways for panning. On better heads, there's a two-stage adjustment usually controlled by a single handle. Twisting the handle part way locks the tilt pivot, but permits the camera to swivel sideways in an arc. This lets you make smooth pan shots with a movie camera without fear that the camera will shift up or down. Twisting the handle farther then locks the pan pivot as well for still pictures. On some tripods, the handle controls only the tilt, and a separate knob locks rotation. This system is designed mainly for heavy equipment. For average use, the single-handle control is simplest.

For maximum flexibility, a tripod head should tilt a full 90°. This enables you to point the camera straight downward for overhead shots. It also lets you flip a horizontal-format camera over on its side for making vertical shots. Some tripods have an added feature that accomplishes the same thing even more easily. This is a hinged platform on top of the head that swings up to turn the camera sideways. Similar tilt-top attachments are also available as accessories.

You won't find every feature on every tripod—you have to choose the ones that are the most helpful for the particular type of shooting you do. If you always use a square-format camera, for instance, a tilt-top tripod is obviously of no special advantage. At the same time, it's wise to plan ahead for future acquisitions. It's a good idea to buy a tripod a little sturdier than you think you really need. As you add longer lenses and heavier equipment, you'll be happy to have some extra rigidity to spare.

Also pick a model that will give you good height. There will be occasions when you'll want to shoot from on top of a chair or stepladder. You can always shorten a tall tripod, but you can't lengthen a short one. For tabletop work or easy carrying in a gadget bag, there are some excellent shorty tripods that shrink down to a few inches in length. But these are best treated as accessories rather than your main equipment. Also useful is a chest pod that hangs from a strap around your neck. This will help to steady a camera when you're moving around too much to use a conventional tripod.

How much should you pay for a tripod? Some hobbyists wince at the thought of spending \$60 on a tripod for a \$50 camera. Actually, the \$50 camera may need a tripod more than a \$250 camera. It depends on how serious you are about your picture taking. You can buy good tripods in the \$30 to \$45 range. As you go down the price ladder, you have to shop a little more carefully because quality varies widely at the low end of the scale. There are respectable \$20 tripods and there are junky \$20 tripods.

In choosing a tripod, take your camera to the store and actually try it on several different models. Check on ease of operation, set-up time and camera stability. You can test for rigidity by positioning the camera so it picks up a light reflection on a piece of bright metal trim. Trip the shutter's self-timer, then step back and watch the reflection. If it jiggles when the timer goes off, the camera moved. Look for a tripod that shows a minimum of movement.

Most of the tripods shown here are nationally distributed and are readily available in local photo shops. Spiratone models are sold by mail from Spiratone, Inc., 135-06 Northern Blvd., Flushing, N.Y. Bilora tripods and accessories are distributed by Ehrenreich Photo-Optical Industries, Inc., 623 Stewart Ave., Garden City, N. Y. The Tiltall model is available from G. M. Marchioni in Rutherford, N.J. ★★★

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VIKING

STOPPING AIRLINER BOMBERS

(Continued from page 97)

developed, a new adsorbing material, styrene-divinylbenzene polymer, was found by IITRI. According to Fischman, it can be used in a chemosensor for the detection of most types of explosives, including dynamite, black gunpowder, plastic and tetraethyl.)

After allowing time for adsorption, the gold foil is heated to about 80°C. (176°F.). This releases adsorbed gases.

Argon, an inert gas which will not contaminate the sample, is injected into the cylinder to carry gases to a second smaller cylinder. The inside surface of this cylinder is also lined with gold to permit further adsorption. Heating occurs and adsorbed gases are released and carried into a gas chromatographic partition tube.

Unidentified material is detector

This tube contains a special material that absorbs and desorbs gases. IITRI officials will not reveal what this material is.

Each gas is absorbed by the material at the front of the tube and is desorbed farther down the tube. Since gases entering the tube are traveling at a different rate—much like our oil-water example above—each is absorbed and desorbed at a different time.

This difference in time is recorded on a meter. Thus, if the meter peaks, say, three minutes after an air sample is taken, EDGN is present. If the peak occurs before or after, the vapor is from a source other than dynamite.

A complete bomb-detection system will probably consist of both neutron activators and chemosensors. Neutron activators will scan baggage in the plane's luggage compartment and that carried by passengers.

A number of chemosensors will be installed in the plane and connected to a monitor in the cockpit. As the plane waits to take off, the pilot will sample the air in the cabin. If EGDN is present, the monitor will show it.

Chemosensors can also act as a backup to detect bombs in a piece of carry-on luggage (attache case or small bag) that someone manages to smuggle aboard. EGDN vapors will seep through most pieces of baggage since they aren't well sealed. Besides, by varying cabin pressure before takeoff, the pilot can get luggage to "breathe."

"Chemosensors have other uses," Fischman claims. "For example, they can be employed to find explosives planted in a building, a gas leak in a mine, and drugs being shipped through the mail." ★★★

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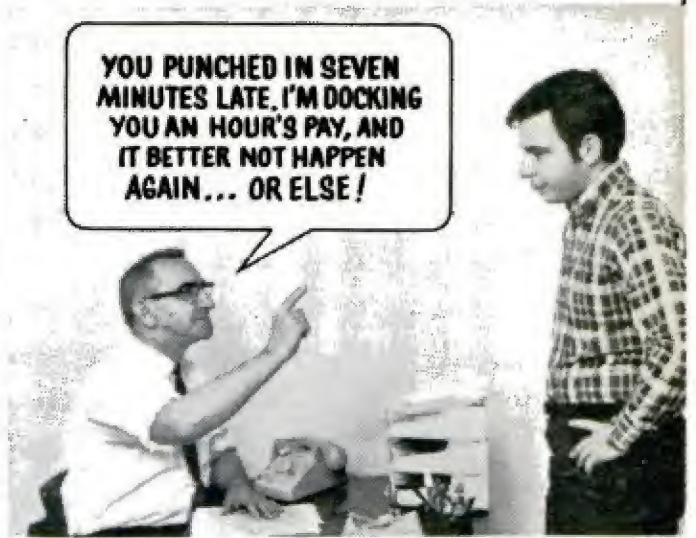
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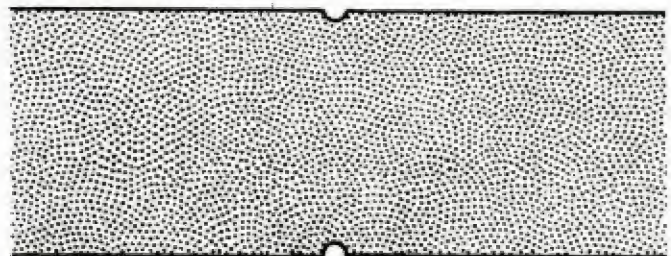
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'A-WAX'...

(Continued from page 75)

AWACS to cover both tactical and air-defense roles. In either role, fighters will provide protection. Otherwise, AWACS would offer a fat target. As the next generation warning system, AWACS will replace the aging SAGE (Semi-Automatic Ground Environmental System), BUIC (Back-Up Interceptor Control) and the existing airborne surveillance system.

The key system aboard AWACS will be an advanced pulsed-Doppler radar called ORT (Overland Radar Technology). ORT's prime task is to recognize and track low-flying aircraft among ground clutter. Natural phenomena plus man's activities produce quantities of electronic flak. Ground clutter confuses ordinary radar from the air, and ground-based radar can't see low-flying airplanes, as the United Arab Republic painfully discovered in the war with Israel in 1967. AWACS will utilize ORT to pick up aircraft flying at any altitude from 20 to 60,000 feet.

The Boeing Co., as prime contractor, will adapt two 707-320 jetliner airframes, largest of the 707 series, for AWACS prototypes. Instead of the usual four engines, eight new-technology General Electric TF-34 engines, installed two to a pod, will power AWACS. Each engine delivers 9600 pounds of thrust at takeoff. The high-bypass engines burn less fuel and extend cruise range despite added drag from the huge 30-foot-diameter radome on top of the fuselage. Efficient engines permit use of the big antenna to assure superior radar performance. Eight engine-driven generators will produce up to four times as much electrical power as the 707 uses in regular airline service to operate radar and communications gear aboard an AWACS plane.

Still to be determined is the Overland Radar Technology contractor. Westinghouse Electric and Hughes Aircraft have developed competing laboratory models. A Westinghouse system will be installed in one prototype, the Hughes system in the second. An old-fashioned electronic "shoot out" will determine the winner in a return to "fly before you buy" competition.

When both prototypes are complete, the Air Force plans to rate each system on two performance counts: (1) ability to detect low-flying aircraft over land amidst a variety of ground clutter; (2) accuracy of tracking of aircraft speeding across land areas. Tolerance limits for tracking precision vary with range and speed. Little is known about techniques or tolerances

because of the secrecy shrouding the program.

In addition to the radars, AWACS will pack more electronic and computer equipment into one airframe than any previous system. Multipurpose consoles include CRT displays as key elements. The consoles will be equipped with communications, navigation and data-processing links plus situation and numerical displays. International Business Machines Corp. will design and install the largest capacity airborne computer ever flown.

With so much electronic gear aboard, troubleshooting and maintenance problems could hold AWACS on the ground much of the time. Boeing plans to develop computerized monitors for continuous checking of the thousands of built-in sensors and "black boxes" scattered throughout the airplane. The troubleshooting system will detect malfunctions and isolate faults for quick servicing. Inputs from the checkout computers and stores of spare parts on board will permit electronics specialists to service most of the systems while in the air.

AWACS is planned for wide-ranging, long-endurance flights. Inflight refueling will enable tankers to transfer fuel while AWACS remains on station. Rest areas in the lower hold will allow crews to work in shifts during missions.

Timing for AWACS calls for completion of the two competing prototypes in late 1972. If either Westinghouse or Hughes develops an acceptable system, production of up to 40 AWACS will begin in mid-1973. AWACS will then become operational to plug existing gaps in our defense systems sometime in 1975. ★★★

GOSSIP BENCH

(Continued from page 154)

the ones in the seat, centered in the rail thickness and bored at right angles.

The pattern for the two arms is traced on 1½-in. stock, bandsawed and then the top edges rounded. From the top view drawing you'll see that the arms butt against the back rail. Two spindle holes are bored in each arm.

This leaves the 11½ x 12-in. telephone shelf which is beveled along the rear edge to meet the slanting back rail. It's glued to both the rail and arm and is supported by two spindles.

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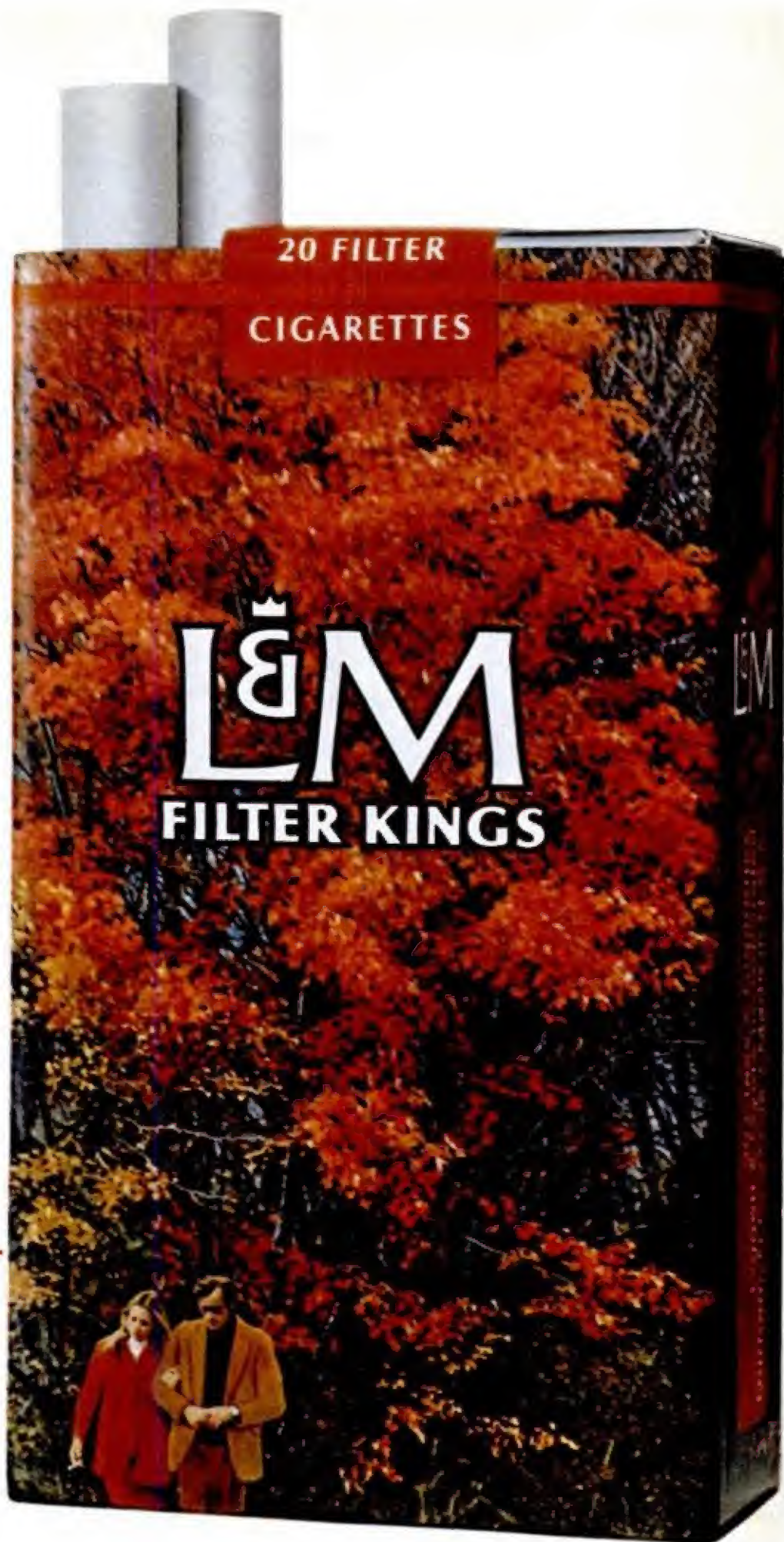
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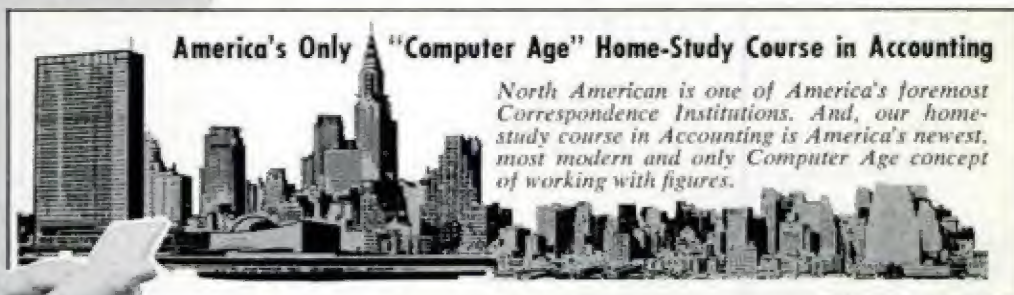
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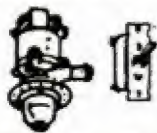
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PM'S TEST: PINTO VS. VEGA

(Continued from page 80)

more constant correcting. The rack and pinion of the Pinto is more positive.

Not once on the entire east-to-west Pinto leg of the trip and the west-to-east Vega leg did I detect any brake fade in the course of normal driving, including many long, downgrade runs. I did test the brakes, however, in a series of stops. On a lonely stretch of Oklahoma road I found less increase in pedal pressure required with the Vega after a series of six hard stops than with the Pinto (which I had also tested in the state of Washington).

Back on the more congested Eastern Seaboard, I missed the Pinto's controls—by controls I mean a combination of the precise steering and instant throttle response while shifting. The Vega's controls are not as easy to coordinate as the Pinto's. I rolled into New York, at last, and went directly to PM Auto Editor Bill Hartford's house on Long Island where we checked over the car. After all that driving, engine oil level was down only one-third quart!

Summing up, after living with each car for three weeks and driving coast to coast: Which car do I prefer? As tested, I choose the Pinto. Despite the Vega's terrific style, better brakes and performance, the Pinto has more to offer as a complete package. Everything seems to hang together better: good workmanship, smooth engine and gearbox; nicely finished interior; precise steering—all in all at \$2029 a better dollar buy. If I could load up Vega with all the goodies, running its price up to the \$3000 bracket, maybe I'd prefer it. But as tested, it's Pinto. ★★

REPAIR A FIBERGLASS BOAT

(Continued from page 119)

to remove excess putty and smooth the spot. Then apply the gel coat.

● *Restoring gloss.* You may want to do this after repair work. However, since it takes very little time for the results you get, you may wish to make it a periodic job.

Wash down the boat with acetone or lacquer thinner to remove loose grit and grime. Using a compound with the grit of Mirro Glaze No. 1, buff the craft with polisher at a 45° angle. Apply minimum pressure to corners and edges to save the gel coat.

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I'LL NEVER QUIT RACING!

(Continued from page 89)

but in looking back, winning the Belgium Grand Prix in 1967. I know it meant a lot to all of us and certainly has meant more to me as the years have gone by.

What was your biggest disappointment in your having failed yourself, knowing you had bobbed something?

One of the first ones was when I went for an audition—to drive for an owner with a stable of Ferraris and Maseratis. I was one of six drivers he invited. We were to progress from Alfa Giuliettas right up to Maserati Grand Prix cars. Well I got as far as a two-liter Ferrari and was going around very, very fast—about three seconds quicker than other drivers who had been in the car—when I came around one turn and was really heavy on it, hanging out the tail. I came over the brow of a hill and it spun around and went off the road backwards. It was one of the most embarrassing blows ever, but it was a great lesson for me. I realized I didn't know everything about driving.

Who's the most underrated driver now competing? Maybe you want to break that down into a couple of different circuits.

In Grand Prix racing I'd say, maybe, Pedro Rodriguez; in championship racing I'd say, maybe, Mike Mosley. I think both, however, lack the understanding of the car that some of their more successful competitors have. It's two strikes against you if you don't have it.

I'm sure you've heard yourself referred to as "Tinker Dan." People say you fiddle and fuss with a car too much. Is that a fair charge?

It's an understandable charge, but not a fair one!

What did you see in Swede Savage that made you think he was worth training as a protege?

Well, he's young and athletic and has a lot of natural talent. He was an outstanding motorcycle rider. His USAC win at Phoenix certainly proves he has what it takes!

Who do you think will be the big names of 1975 in world auto racing?

It's too far for me to see. I would hope Swede will be among the top ones.

Did Swede have any particular problems or faults when he started out?

He needed experience; he had to develop judgment.

Was he brash when he started or was he too brave?

I think every driver has a tendency to be a little bit too brave.

Do they have it more when they start out, when they're young? Or did they acquire it with experience?

It's ignorance more than it is bravery. When they get more experience and have more knowledge, their judgment improves. They're just as brave, maybe braver, but they don't take the same chances. They don't drive into the unknown as blindly.

You had the experience of being eliminated in that first-lap pile-up at Indianapolis in '66, and you've also had the experience of being eliminated in the last lap. Which is most frustrating?

I'd say on the first lap. In the case of Indianapolis you've put in at least a year's preparation, and you're all charged up to finally go out and do it. If you are forced out early, it's a big letdown.

Even in a race where you go only half-way and run a good race, do you feel some satisfaction?

Sure.

Al Unser's championship car almost ran away from everybody in championship racing last year. His dirt-track car was almost unbeatable too. How were they able to build him such a good dirt-track car? It really has little in common with the Indy car except the same mechanics.

Well, you shouldn't take anything away from Al. And, of course, George Bignotti and Parnelli and their whole organization were outstanding. They have a great depth of knowledge and certainly used it.

It just surprised us that they were able to do it on both circuits.

Yes. They'll be tough again this year, but they'll be awfully disappointed when we beat 'em!

You don't build a dirt-track car, do you?

No. We would like to go into dirt-track, though, and we have built several engines for Mario Andretti. The engine itself looks very good. It's based on a stock-block Ford.

Are speeds too fast, Dan? Would races be just as exciting to the fans at 150 mph say as at 180 or at 100 as at 120?

That's an old question, and I don't think there is an answer to it.

When a driver's going 200 mph, or even

(Please turn to page 230)

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(Continued on next page)

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(Continued from preceding page)

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(Continued on next page)

I'LL NEVER QUIT RACING!

(Continued from page 210)

190 mph, at Talledega, is that too fast?

If you ask the drivers who've done it, I think they'd prefer racing a little slower.

You'd say that good racing depends on the competitiveness of the racing more than all-out speed?

I'd go along with that, quite a bit.

In road racing the lead doesn't seem to change often enough. In oval racing, particularly stock-car racing, you'll have eight or ten guys, and the lead will change every time they go around the track. In road racing they tend to string out.

Well, yes. I think that's true, although the pit stops are accounting for the lead changes as much as the track itself. When you have road racing with pit stops you'll find the same sort of lead-changing. It is, I think, more man-against-the-track in road racing rather than man-to-man as in oval racing, although that's a broad statement that doesn't always hold true.

Yes, we felt that way after riding around the Nurburgring with John Fitch last year. A driver only goes around about 11 or 13

times in a race, and he doesn't get very familiar with it.

Of course, that's a unique track, but not necessarily the most challenging. I held the record there a few years, by the way.

It's a much more complicated race track than Hockenheim?

Yes, and you're very aware of the tradition. It's an awe-inspiring place. I think most Grand Prix drivers would pick the Nurburgring as one that they'd like to win.

You won there once, right?

Yes, a 1000-kilometer race in 1960, co-driving a Maserati with Stirling Moss. At the Nurburgring they get tremendous crowds. They get really stirred up. I've seen hundreds of thousands of people lining that track in the pouring rain waving their umbrellas at you.

Are Grand Prix fans different in different countries?

Sure. Just like the countries are different, the circuits are completely different and so are the fans.

A little like showbiz: You're well aware of playing to a certain audience?

Yes, that's the way it is!

★ ★ ★

MISCELLANEOUS

(Continued from preceding page)

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